LUME XVI OCTOBER, 1916 NUMBER 6

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DEVOTED TO NATURAL HISTORY, EXPLORATION AND THE DEVELOPMENT OF PUBLIC EDUCATION THROUGH THE MUSEUM

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Courtesy Boston Museum of Fine Arts

THE FAMOUS PAINTING, "WATSON AND THE SHARK," BY JOHN SINGLETON COPLEY, DEPICTS A THRILLING RESCUE FROM A "MAN-EATER" IN HAVANA HARBOR

The subject of the picture (probably chosen by the artist to exhibit skill in portraying flesh tints under water) is a bathing accident not dissimilar to those recently recorded on the New Jersey coast. Brooke Watson, an American, who afterward became Lord Mayor of London, lived as a youth in Jamaica, and it was while bathing in these tropical waters that the gruesome encounter with the shark occurred. Watson escaped from the encounter with only the loss of a leg, owing to the heroic work of a boat's crew in the harbor, and the story goes that when as Lord Mayor he was questioned in after years about the loss, he delighted to mystify the inquirers by replying gleefully "It was bit off!" The original of this picture, painted in 1778, belongs to Lord Aberdare; a duplicate is in the Boston Museum of Fine Arts

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Sharks — Man-eaters and Others

WITH SUGGESTIONS THAT AMERICANS TURN TO ECONOMIC ACCOUNT SOME OF THE SMALLER SPECIES OF THE ATLANTIC COAST

By HUGH M. SMITH

United States Commissioner of Fisheries

The unprecedented attacks by sharks on human beings along the middle Atlantic coast of the United States in the summer of 1916, resulting in the death of four bathers, produced a profound sensation and materially interfered with the attendance at seaside resorts, while leading to an astonishing amount of newspaper discussion in the course of which the public was regaled with more fiction and also more facts about sharks in general than ever before in our history. Several departments of the federal government became involved in the matter, various individuals and committees offered rewards for the capture of "man-eating" sharks, and a bill was introduced in Congress appropriating money for the purpose of enabling the Department of Commerce to coöperate in the extermination of man-eating sharks on the New Jersey coast.

The Bureau of Fisheries was incessantly importuned to explain why sharks were behaving as they were, and to take action that would prevent further attacks. There was some criticism of our inability to cope with the situation, although obviously there was little that could be done. The culprits were never identified. It was not known whether one individual shark of a species common to the region was running amuck; whether representatives of several local species had been forced to attack human beings because of certain undetermined biological or physical conditions; or whether there was an advent of a shark or sharks from distant waters with feeding habits different from those of the domestic species, which in no former years had exhibited any man-eating tendency and were dangerous only when they themselves were attacked.

There were no attacks reported after the middle of July and the scare subsided; but out of all the excitement and discussion there has arisen a keen lay interest in sharks — their kinds, habits, size, distribution, and economic value; and in answer to that interest there have been special displays in museums and publication of much authentic matter in the secular and scientific press.— HUGH M. SMITH.

THE term "man-eater" is applied by the public to almost any shark of medium or large size, and during the recent scare any shark over five feet long was likely to be called a "man-eater" and recorded as such in the daily press. The writer saw a published photograph of a "man-eater" shark and its proud captor; assuming the height of the man to have been six feet, the shark could not have exceeded three feet in length. In fish literature the name "man-eater" is restricted to the white shark [*Carcharodon carcharias* (Linnæus)], known also as the great blue shark. The name man-eater is justified, however, only by the large size, formidable teeth, voracity, and obvious ability of the fish to kill and eat human beings; it is certainly not warranted by a confirmed man-eating habit.[1] While

[1] In this connection it is interesting to quote the opinion of Mr. J. T. Nichols of the American Museum and Mr. Robert C. Murphy of the Brooklyn Museum,

this fish occurs regularly, although not abundantly, in summer along parts of our coast where sea bathing is extensively indulged in, it must be regarded as comparatively inoffensive in our waters even if the recent fatalities on the New Jersey coast are attributable to it.

The genus Carcharodon reached its climax in the past, during the Eocene or Miocene, when fish immensely larger than any now existing must have roamed the seas. It has been thought that, because of the size of the fossil teeth,[1] individuals seventy to eighty feet long must have been common. The model[2] of the jaws of a shark of this genus in the American Museum of Natural History suggests the colossal proportions attained in geological times. In these degenerate modern days the maximum length reached by the white shark appears to be about forty feet, with teeth three inches long. The British Museum contains the jaws of a specimen thirty-six feet long from Australia. The gustatory feats that can be performed by fish of such size may be judged by the accomplishment of a thirty-foot individual on the California coast which had in its stomach an entire sea lion weighing one hundred pounds. The writer has before him a note on a shark of this species collected by a Bureau of Fisheries party at Menemsha Bight, Martha's Vineyard, on August 19, 1916; it was twelve feet eight inches long, and more than five feet in girth at the pectorals, and was estimated to weigh one thousand pounds.

In the same family with Carcharodon, and distinguished therefrom by having the edges of the teeth entire instead of serrate, are the mackerel sharks, of which four species may be found on the Atlantic coast.[1] One of these,[2] a cosmopolitan species in temperate latitudes, is the "porbeagle" of England, [*Isurus nasus* (Bonnaterre)].[3] It attains a length of ten to twelve feet. The common species on the east coast of the United States is the "blue shark" of the Cape Cod fishermen, [*Isurus punctatus* (Storer)], readily distinguishable by the large black spot on the pectoral fin. It reaches a length of eight to ten feet. The mackerel sharks are handsome, trim, and active species, and are so named because they are present chiefly during the mackerel season and prey largely on that fish. They are sometimes very annoying to purse-seine, pound-net, and gill-net fishermen.

Related to the mackerel sharks anatomically, but differing markedly from them in habits and disposition, is the basking shark or bone shark (*Cetorhinus maximus*). These names have been applied by our fishermen in allusion to the facts that the fish often remains

who consider the circumstantial evidence sufficient to convict the white shark in spite of lack of definite proof against it:

"White sharks are so scarce that their habits are little known, but they are said to feed to some extent on big sea turtles, biting off their legs and even cutting through their shells. Of this species it may be said that judging from its physical make-up it would not hesitate to attack a man in the water.... Even a relatively small white shark, weighing two or three hundred pounds, might readily snap the largest human bones by a jerk of its body after it had bitten through the flesh. The occurrence of the white shark near New York being almost as unprecedented as the attacks on bathers which happened simultaneously, the capture of a specimen by Mr. Schliesser confirms our belief that the white shark was responsible for the casualties."

These views of Messrs. Nichols and Murphy are stated in full in the *Magazine Section* of the *New York Times* for August 6, 1916.— THE EDITOR.

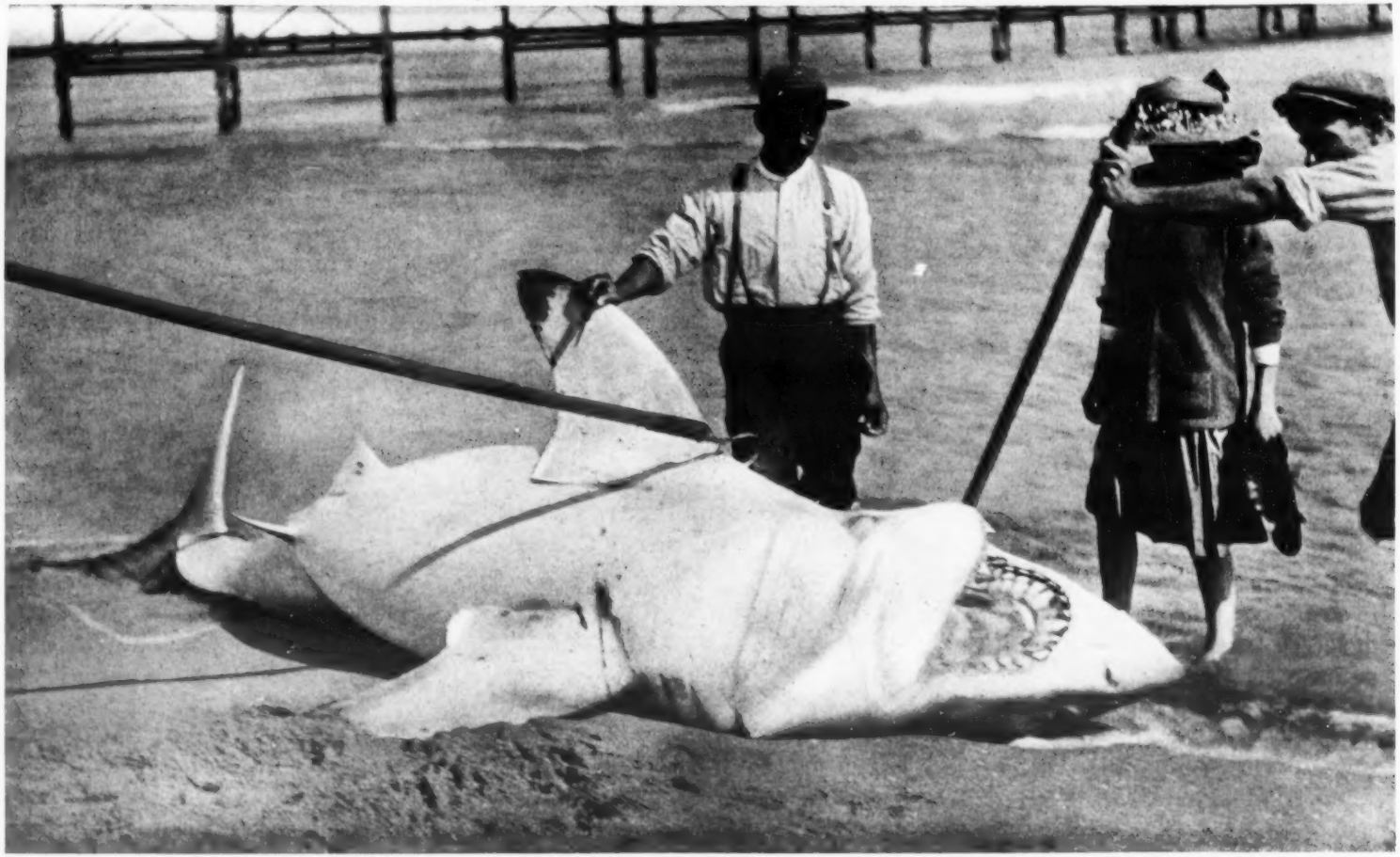
[1] Opinion of the late Dr. George Brown Goode.

[2] See photograph on back cover of JOURNAL.

[1] All of these are now placed in the genus Isurus by Garman. *The Plagiostomia*. 1913.

[2] Another form ranging from New York to the West Indies, was described in 1869 by Captain Atwood as *Carcharias tigris* but has not been recognized by later writers; it appears to be a distinct species and may be called *Isurus tigris*. It attains a length of ten feet or more.

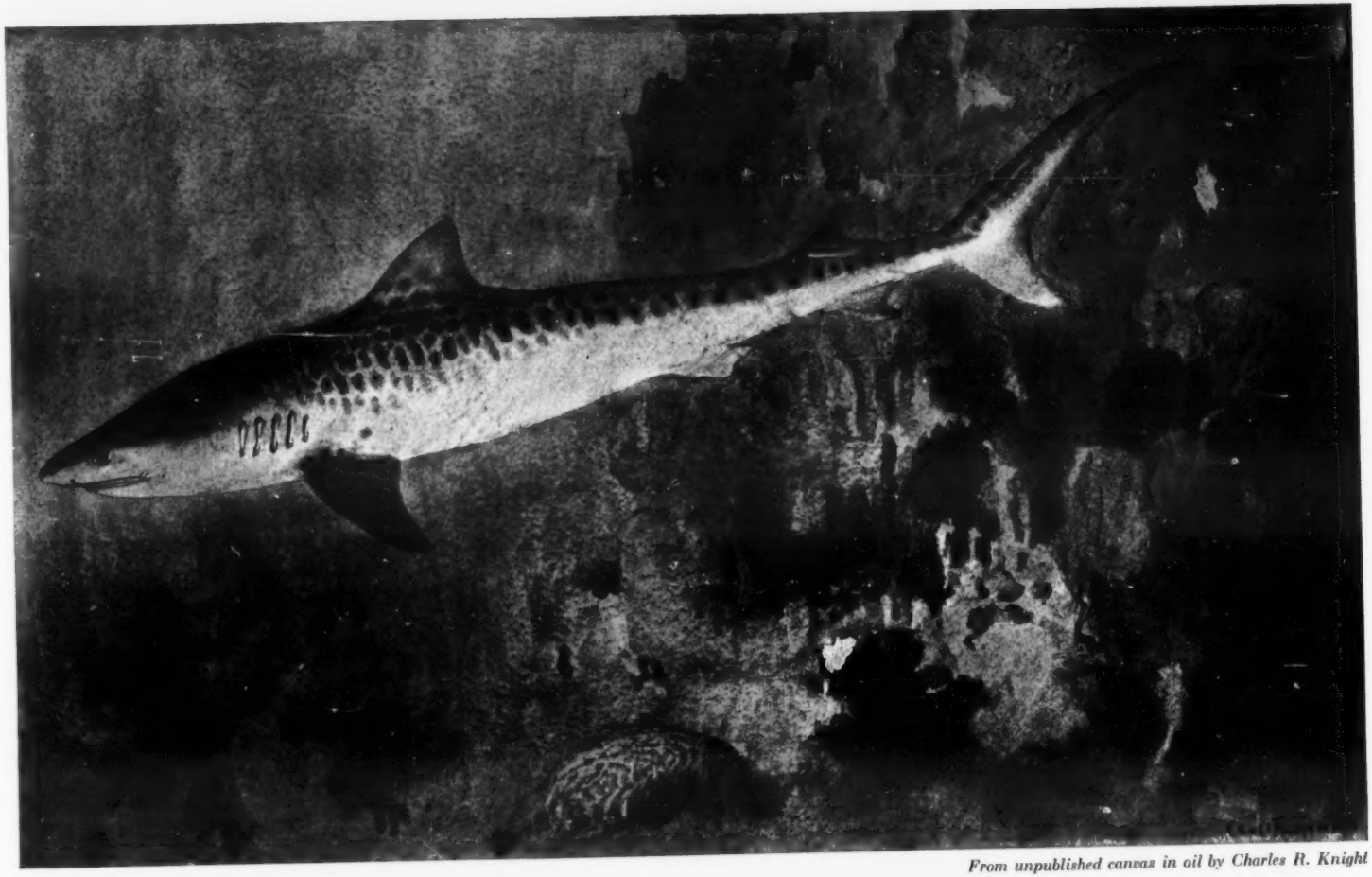
[3] Generally recorded in recent literature under the name *Lamna cornubica* (Gmelin).



Courtesy of Mr. Sidney M. Colgate

GREAT WHITE SHARK OR MAN-EATER, TAKEN OFF PALM BEACH, FLORIDA

This young twelve-foot specimen of the great white shark (*Carcharodon carcharias*) was taken by Mr. Sidney M. Colgate in December, 1913, while out hunting sharks with his family. Man-eaters were not expected; other sharks generally succumb quietly when harpooned. This creature, however, when struck, turned and bit the wooden harpoon pole in two, attacked the launch with such vigor that it sprung a leak, and was only finally dispatched by several revolver shots. These sharks are characterized by large size and voracity, and by unusually large mouth and teeth, which render them very capable of man-eating, and circumstantial evidence also accounts for their sinister name. The maximum length attained is about forty feet, with teeth three inches long, but from the size of fossil teeth found it is thought that in the past individuals of the same genus (Carcharodon) must have attained a length of seventy to eighty feet. The white shark inhabits tropical waters and is rarely found within fifty miles of New York



From unpublished canvas in oil by Charles R. Knight

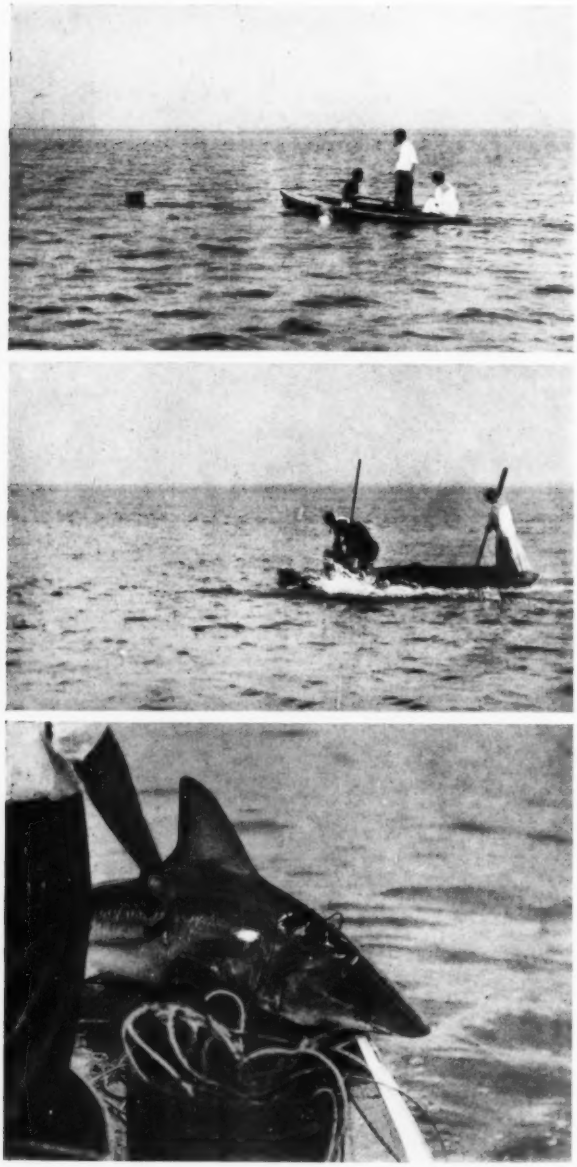
THE LEOPARD SHARK IS ACTIVE, GRACEFUL AND FEROCIOUS

The largest shark taken in the vicinity of New York is likely to be the leopard or tiger shark (*Galeocerdo arcticus*), a tropical fish which occasionally reaches this latitude. It swims in schools, attains a length of thirty feet, and is much dreaded in West Indian waters, although it is not known how dangerous it may be. It feeds upon shellfish and squids as well as upon fishes

From unpublished canvas in oil by Charles R. Knight

HAMMER-HEAD SHARK IN NATIVE HAUNT

Its curious head, which in a large specimen may measure a yard from eye to eye, is the distinguishing feature of the hammer-head shark (*Sphyrna zygæna*), a cosmopolitan fish not infrequent along the Atlantic coast in summer, as far north as Massachusetts. It attains a length of fifteen feet, and a specimen caught at Riverhead, New York, in September, 1805, contained the detached remains of a man and also a striped cotton shirt. The family to which the hammer-head belongs includes a series of forms with strangely shaped heads, varying from bonnet-shaped to this exaggerated hammer-shaped type



Photos by J. T. Nichols

Hunting brown sharks (*Carcharhinus milberti*) in Great South Bay, Long Island. The shark is harpooned from the bowsprit of a sloop, a bucket being attached to the harpoon line. A tender is lowered which picks up the bucket and hauls up to the shark (upper picture). The shark is then lanced (middle picture) and hauled on board. This species is not dangerous and is common in this vicinity in summer. In a recently published paper Mr. Edwin Thorne, from whose sloop the above photographs were taken, mentions taking fourteen brown sharks in one day, and of the hundreds he has caught at various times all but two have been females. These enter the Great South Bay in midsummer to give birth to their young and may be found there until September. The brown shark feeds on crabs, lobsters, and various fishes. Its fin and tail are seldom seen above the surface, as are those of pelagic sharks

quiet at the surface for a long time and that the gill arches are provided with strainers which resemble whalebone. This fish was described by the Norwegian bishop Gunner in 1765 in a learned paper in which he sought to prove that this must have been the "great fish" that swallowed Jonah. From the standpoint of mere size, the basking shark fulfills all the requirements, for it is one of the largest of sharks and the ingestion of a prophet would have entailed no difficulty or inconvenience. A length of fifty feet has been claimed for it, but the available authentic records give a maximum of under forty feet. It is at home in the Arctic seas, but sometimes has strayed as far southward as Virginia and California. In former years it was not uncommon on the New England coast and also on the shores of western Europe; and it was regularly hunted for its oil in Ireland and Norway. In the early eighteenth century, and in the early part of the last century, it was not infrequently harpooned by the Maine and Massachusetts fishermen, and the liver of a large specimen has been known to yield twelve barrels of oil. From Eastport, Maine, and Provincetown, Massachusetts, and even from the lower harbor of New York, quite a number of individuals ranging from twenty-eight to thirty-five feet in length have

been reported, but recently the species is rare in our waters. Its disposition is peaceful, and it is dangerous only because of its great bulk. When attacked, its powerful tail easily demolishes boats, and its pursuit has been attended by considerable excitement and risk.

The thrasher or swingle-tail (*Vulpecula marina* Valmont) is another large and active pelagic shark which is common along the coasts of New England and western and southern Europe, and is known also from California. It is at once distinguished from all other sharks by its prodigious tail (see page 354), the upper lobe of which, in the form of a scythe blade, is half the total length of the fish. The fishermen tell tales of the ferocity of this shark in attacking whales, which, when they come to the surface to breathe, are said to be flailed by the thrasher's flexible tail, so that the resounding whacks may be heard for several miles in calm weather. Authentic observations of this habit are lacking. The species is certainly harmless for man, in spite of its large size — it attains a length of fifteen feet and a weight of five hundred pounds. It is a source of some annoyance to our mackerel fishermen because it often becomes entangled in the nets. In July, 1904, an imperfect skeleton of this fish about ten and one-half feet long, with cranium and two hundred and seventy-four vertebræ, was exhibited at Atlantic City, as that of a "sea serpent," and an impossible account of its capture was published in the local newspapers at the time.[1]

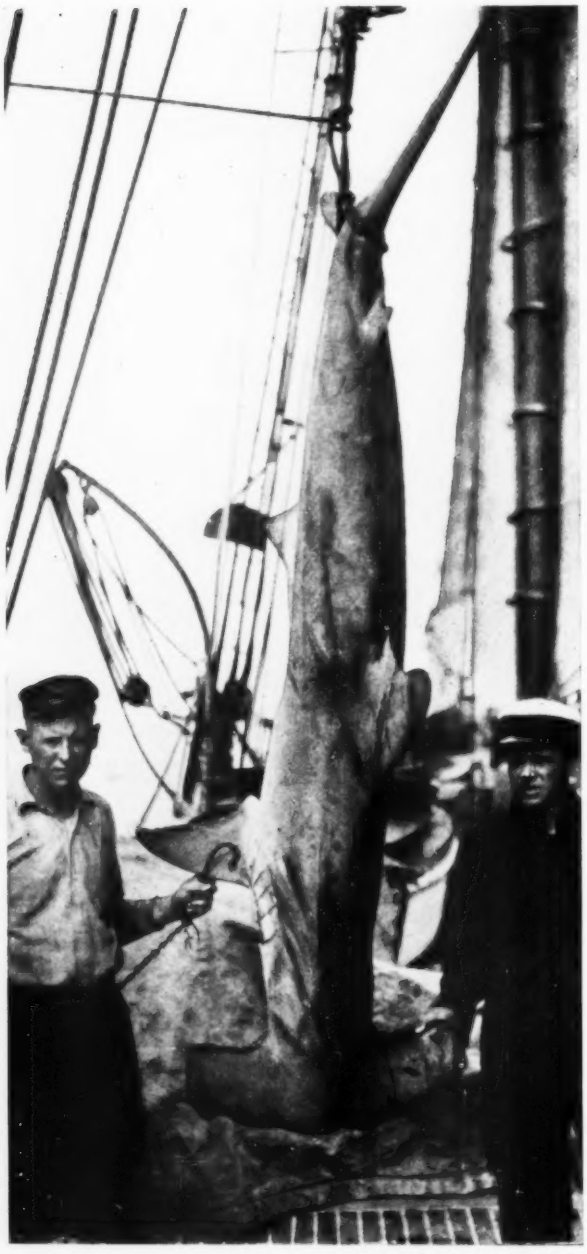
In strong contrast with the striking modification of the tail in the foregoing species, the hammer-head and the bonnet-head sharks [*Sphyrna zygæna* (Linnæus) and *S. tiburo* (Linnæus)], present grotesque lateral expansions of the head. Both species range from the tropics along our east coast as far as Massachusetts. The former is a voracious species and, attaining a length of more than fifteen feet, is formidable to man; the latter, much the commoner on our South Atlantic coast, rarely exceeds five feet in length. Mitchill's *Fishes of New York* records the capture of three hammer-heads in a net at Riverhead, New York, September, 1805; the largest, eleven feet long, contained the detached remains of a man and also a striped cotton shirt.

The sand shark [*Carcharias taurus* (Müller & Henle)] is one of the best-known sharks of our Atlantic coast. It is sometimes called "shovel-nose shark" and "dogfish shark" on the shores of New England. Its usual length is under five feet, but it is said, perhaps on account of error in identification, to attain a length of twelve feet and a weight of two hundred and fifty pounds. It is built on rakish lines, its snout is sharp, its crescentic mouth is armed with long and narrow teeth, the fishermen say it has a wicked eye, and its disposition is vicious. It is able to do very serious injury to careless fishermen who are trying to remove it from their nets or boats, and the writer has seen it inflict fearful wounds on other species of sharks confined with it in the observation pool at Woods Hole, Massachusetts.

The largest family of sharks in our waters is the Carcharinidæ.[1] The many

[1] For identity of this skeleton, see note by the writer in *Forest and Stream*, December 3, 1904.

[1] Our commoner species are the sharp-nosed shark, *Scoliodon terræ-novæ* (Richardson), ranging from Massachusetts southward, numerous on the South Atlantic coast, and reaching a length of seven feet; *Aprionodon isodon* (Müller & Henle), originally described from New York and now known from North Carolina and various other places on the shores of the western Atlantic; *Hypoprion brevirostris* Poey, reported by Radcliffe as fairly common on the North Carolina coast, the largest individual taken being over eight feet long; *Carcharhinus platyodon* (Poey), a common form in the Gulf of Mexico and throughout the West Indies, attaining a length of ten to twelve feet;



From photo by W. W. Welsh

This ten-foot hammer-head shark was caught off Cape May, New Jersey, in August, 1916, by the United States Fishery schooner "Grampus." It appeared when one of the crew was swimming near the vessel and took a hastily baited hook as soon as one was put overboard. When caught with rod and line the hammer-head is said to be one of the gamest of sharks, continuing to struggle violently until it dies from exhaustion. This shark probably breeds in the neighborhood of New York, as a very small one has been found on the Long Island shore, and most of the specimens captured in the north are not full grown

genera however are not always easily distinguishable until the teeth and dermal denticles are carefully examined (see page 350).

Two of the most interesting are the blue shark (*Galeus glaucus* Valmont), a world-wide species attaining a moderate size, characterized by the very dark blue color of the upper parts; and the tiger shark, or leopard shark (*Galeocerdo arcticus* Faber), an active, graceful, ferocious species, with razor-like teeth. The latter is known from Provincetown, Woods Hole, and other places on the Atlantic coast.[1]

the black-finned shark, *C. limbatus* (Müller & Henle), of almost cosmopolitan distribution in tropical waters, known from our coast since 1875 when specimens were taken at Woods Hole, where also a five-foot individual was observed by the writer in July, 1916; the cub shark, *C. lamia* (Risso), a common form on our southeast coast, represented in the American Museum of Natural History by a model of a specimen taken at Key West, an individual taken with rod and line in North Carolina in 1902 having been over nine feet long and five feet in girth; the dusky shark, *C. obscurus* (Lesueur), a very numerous species in southern Massachusetts in summer, common along the middle Atlantic coast, frequently taken with lines and nets, attaining a length of fourteen feet; the brown shark, *C. milberti* (Müller & Henle), often confused with several other species, not rare on the Atlantic coast from Cape Cod southward; and *C. acronotus* (Poey), a Cuban form of which a number of specimens were recently taken in North Carolina.

[1] The following interesting account of captures in North Carolina is given by Radcliffe (*The Sharks and Rays of Beaufort, North Carolina, 1916.*):

On August 8, 1914, a small school of large tiger sharks appeared in the Fort Macon Channel near the fisheries laboratory and swam around the "Fish Hawk." A baited shark hook

Scientific names of fish are not always expressive of obvious habits or structure, but *Somniosus microcephalus* (Bloch & Schneider), or the "small-headed sleeper," aptly describes a large boreal shark that makes occasional visits to our coasts as far south as Cape Cod and Oregon. Its body seems to have developed at the expense of its brain, for it is a sluggish stupid glutton that reaches a length of twenty-five to thirty feet. It is said to be a very active foe of whales. When caught in the fisheries of western Europe, the sleeper shark is brought in by the fishermen and offered for sale as food, although its market value is small. The writer has seen it in the markets of Grimsby, Cuxhaven, and Hamburg.

One of the rarest and at the same time most strongly differentiated sharks on the coasts of the United States is the cow shark [*Hexanchus griseus* (Gmelin)], at once recognizable by its single dorsal fin, and its six gill apertures (see page 351). The dentition also is peculiar.[1] There appears to be only one instance of the occurrence of this shark in our waters, although it is said by Poey to be often found about Cuba. An individual ten feet two inches long was taken in 1886 at Currituck Inlet, N. C., a plaster cast of which is in the United States National Museum. On the shores of western and southern Europe, where the cow shark is most common, it attains a length of twenty-six feet or over.

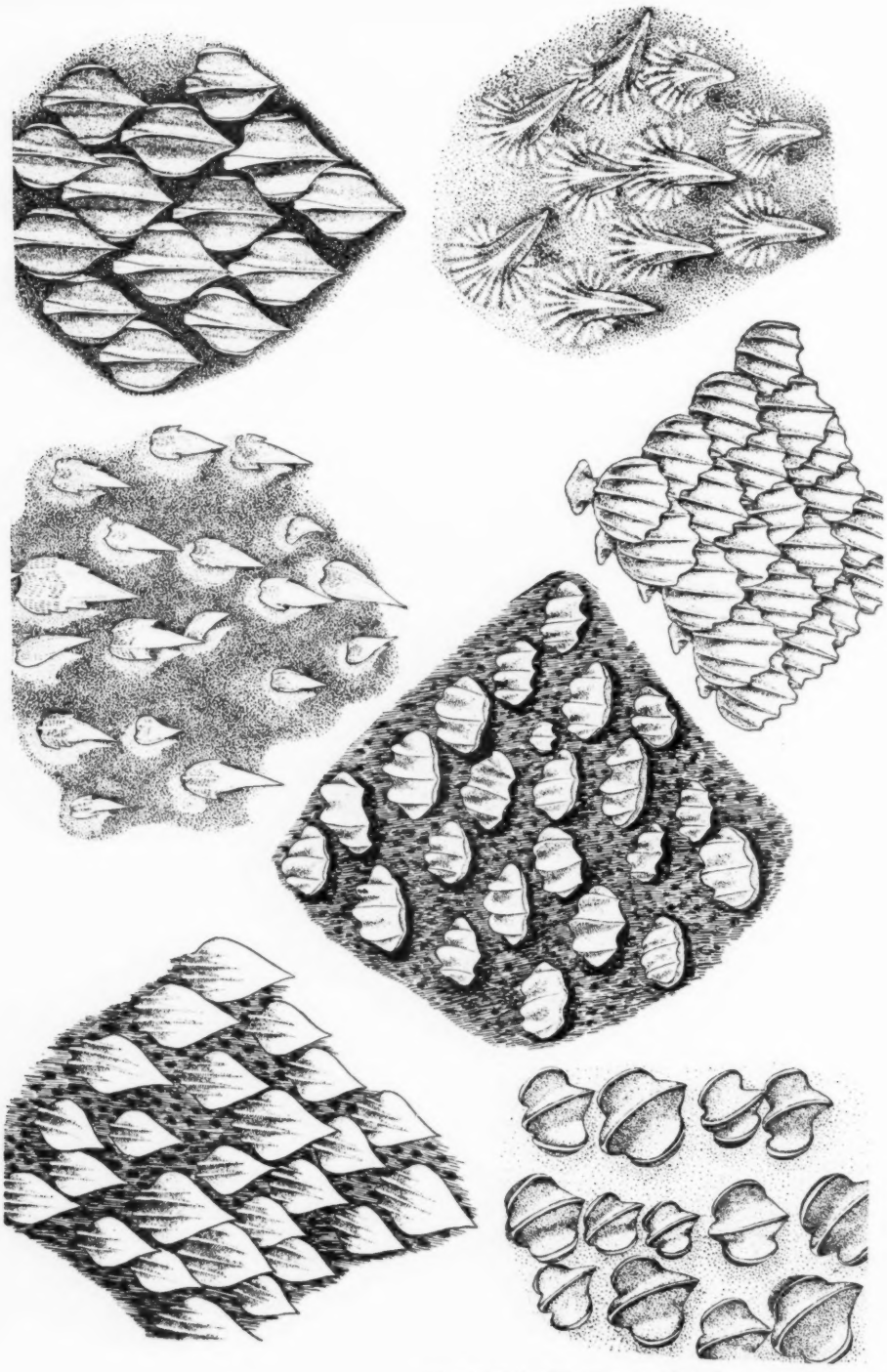
Among the most interesting sharks of the world are the deep-sea species. The extreme depth at which sharks have been found is about one and one-sixth miles. The deep-sea forms are for the most part small, of a blackish or dark brownish color, and do not exhibit any marked structural differentiation from the littoral and pelagic species. There have been taken off the east coast of Africa and in the Gulf of Aden (on the "Valdivia" cruise), at a maximum depth of 1,006 fathoms, several specimens of a hitherto unknown shark [*Apristurus indicus* (Brauer)]. The largest is thirteen inches long. This species inhabits a greater depth than any other shark, as far as known.[2]

One of the most striking of the deep-sea sharks is a form taken by the

thrown over the side was seized by the largest of the school. The line offered little resistance to this big fellow and he disappeared, taking bait and hook with him. During the time that elapsed while another hook was being secured and baited, the rest of the school came up under the stern of the ship, showing no fear of the men in the cockpit a few feet above them. Apparently the sharks were very hungry and were prepared to grasp anything that might fall to them in the nature of food. When the second hook was thrown over, it was seized by one of the school. This shark, which was killed and brought on deck, was eight and two-thirds feet in length. For the second time this hook was thrown overboard and soon another specimen, ten and one-twelfth feet in length was captured and hung from the end of the boom with its head out of the water. On the third cast, another, nine and one-sixth feet in length, was captured. About this time a shark, larger than any of those taken, swam up to the one hanging from the boom, and raising its head partly out of the water, seized the dead shark by the throat. As it did so, the captain of the "Fish Hawk" began shooting at it, with a 32-caliber revolver, as rapidly as he could take aim. The shots seemed only to infuriate the shark, and it shook the dead one so viciously as to make it seem doubtful whether the boom would withstand its onslaught. Finally it tore a very large section of the unfortunate's belly, tearing out and devouring the whole liver, leaving a gaping hole across the entire width of the body large enough to permit a small child easily to enter the body cavity. At this instant one of the bullets struck a vital spot, and after a lively struggle on the part of the launch's crew, a rope was secured around its tail. The four specimens, all females, were brought to the laboratory for examination. The last shark was twelve feet in length, and the liver of the smaller one was still in its stomach, the estimated weight of which was forty pounds.

[1] In the front of the upper jaw there are four pointed teeth, on each side of which are three with one or several cusps, and laterally the teeth have many cusps; while in the middle of the lower jaw there are a small tooth with or without a cusp, and lateral serrated teeth with many cusps.

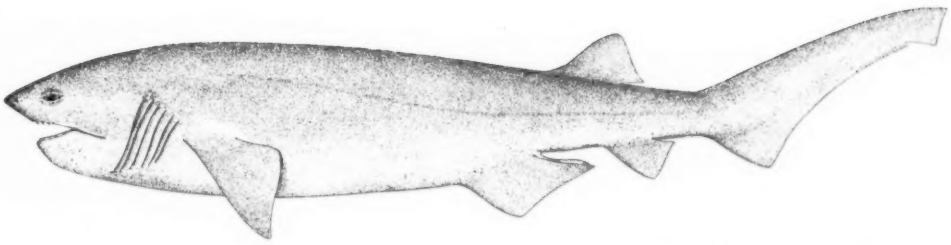
[2] *A. profundorum* (Goode & Bean) comes from a depth of 816 fathoms off the middle Atlantic coast. Another member of the same family, *Halælurus canescens* (Günther), was taken from 400 fathoms off the southwestern coast of South America by the "Challenger," while *Halælurus alcocki* Garman comes from 620 to 690 fathoms in the Arabian Sea. Among the Squalidæ, the family to which our common spiny dogfish belongs, there are several deep-sea species:



From Bulletin of the Bureau of Fisheries, Vol. XXXIV, 1914

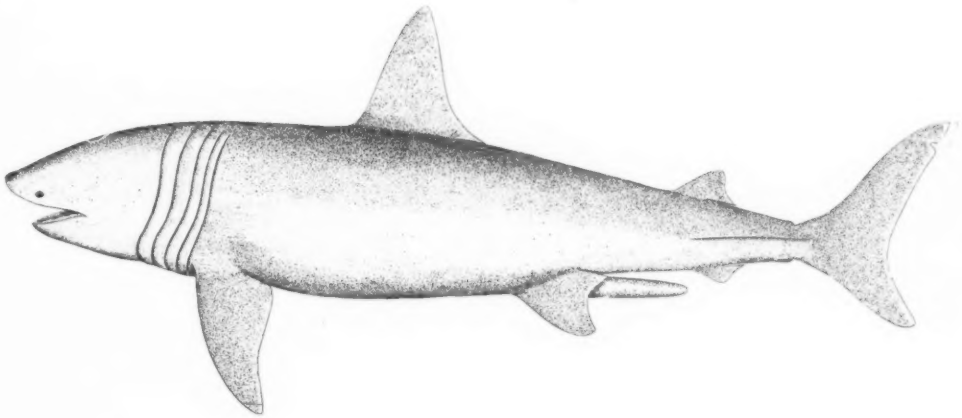
SHARK SKIN UNDER THE MICROSCOPE

The skin of a shark has no scales, but is rough like sand paper owing to numerous minute asperities called "dermal denticles." These when viewed under the microscope are seen to be of various forms, each form characteristic of the species of shark it is found upon. In his paper *The Sharks and Rays of Beaufort, North Carolina*, Mr. Lewis Radcliffe has even made the denticles a criterion for separating closely related species. In the case of the nurse shark (*Ginglymostoma cirratum*) the denticles are so large and strong that it is difficult to drive a harpoon into the fish



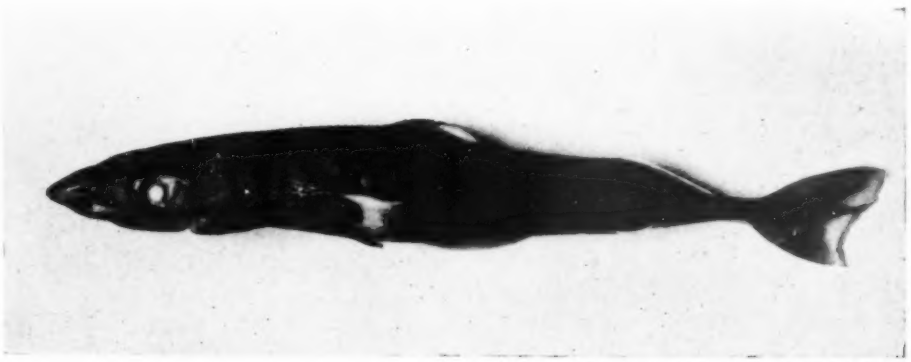
Courtesy United States Bureau of Fisheries

The cow shark (*Hexanchus griseus*) is a primitive type of shark, peculiar in possessing six gill slits; most modern sharks have but five. Its single dorsal fin is also a distinguishing feature. It attains a length of twenty-six feet but is rare on United States coasts



Courtesy United States Bureau of Fisheries

Basking or bone shark (*Cetorhinus maximus*). A harmless, sluggish, gigantic shark (nearly forty feet long) at home in the Arctic seas but sometimes straying south. Has been described as the fish that swallowed Jonah, but, in spite of its huge size and wide mouth, its minute teeth and large gill openings show that it feeds on very small marine creatures



Courtesy United States National Museum

The smallest shark known (*Squaliolus laticaudus*), adult female, represented natural size. It is a deep-sea form represented at present by a single pair taken in Philippine waters, at a depth of one hundred and seventy fathoms. The deep-sea sharks are mostly small and dark colored but in structure do not differ markedly from other species

"Albatross" in Batangas Bay, Luzon, Philippine Islands, at a depth of one hundred and seventy fathoms.[2] It is cylindrical, slender, with very narrow peduncle and very broad tail, and is jet black, with the fins wholly or partly white. The species is represented by a single pair, of which the fully developed male (which is larger than the female) measures less than six inches in length. It is believed that no other shark is so diminutive.

We have not yet spoken of the largest of all sharks — which means the largest of all fishes of the world. This is the "whale shark" (*Rhinodon typicus* A. Smith), originally described from Cape of Good Hope, but now known from India, Japan, South America, Panama, California, and various other places. There have been two individuals taken on the coast of Florida, the first, a rather small one (eighteen feet long) obtained at Ormond in 1902; the second a veritable monster, caught at Knight's Key in June, 1912. The skin of the fish was stuffed in a distorted shape (see opposite page) and exhibited in various parts of the country as "The Only Creature of the Kind in the World." The advertised length of the fish was forty-five feet, but from the best information obtainable it was somewhat more than thirty-eight feet long before stuffing.

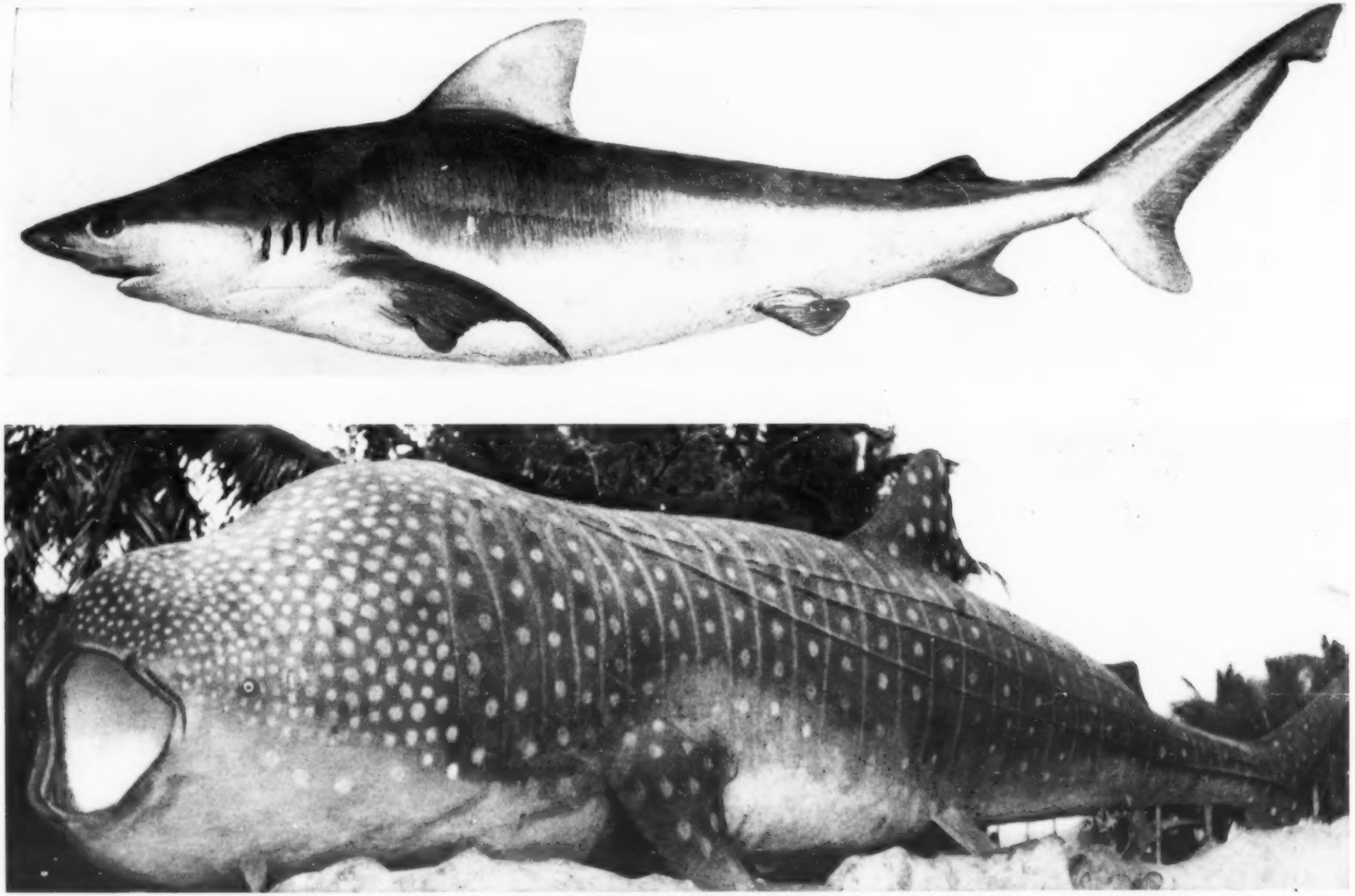
This shark has a very broad and obtuse snout and an exceedingly wide mouth armed with numerous minute teeth; the dark-colored body is marked with many small whitish spots. The species is stated to attain a length of seventy feet and is known to exceed fifty feet. Notwithstanding its immense size, however, it is harmless to man unless attacked, and feeds on the small creatures for which its teeth are adapted. Its huge bulk makes it dangerous in the same way that a whale is dangerous. Years ago it was reported that the sperm-whale fishermen on the island of Saint Denis, in the Indian Ocean, dreaded to harpoon a whale shark by mistake, and stories are told of how a harpooned fish "having by a lightning-like dive exhausted the supply of rope which had been accidentally fastened to the boat, dived deeper still, and so pulled a pirogue and crew to the bottom."

The sharks most numerous on the United States coasts are the small forms known as dogfishes, which belong in two distinct families and get their name from their habit of going in droves or packs like wild dogs. The smooth dogfish (*Galeorhinus lævis* Valmont), is one of the omnipresent fishes of the Altantic coast in summer from Cape Cod to Cape Hatteras, and is abundant on the lower Carolina coast in spring. It is a slender graceful species, without spines in the dorsal fins, reaching a length of three feet, and having pavement-like teeth adapted for crushing lobsters, crabs, and other bottom-loving creatures. The horny or spiny dogfish (*Squalus acanthias* Klein) is found on both sides of the North Atlantic and is easily the most abundant and most destructive of our east-coast sharks.[1] The spiny dogfish ranges as far north as the Gulf of St. Lawrence and south to North Carolina, and reaches its maximum abundance

Scymnodon ringens Bocage & Capello, from 765 fathoms off Japan, from the "Challenger" expedition; *Acanthidium profundorum* (Smith & Radcliffe), from 736 to 976 fathoms in the Philippine Archipelago, from the "Albatross" expedition; *Etmopterus brachyurus* Smith & Radcliffe, from 263 fathoms off Joló, Philippine Islands, taken by the "Albatross"; *Centroscyllium nigrum* Garman, from 546 to 555 fathoms in the North Pacific off Colombia, taken by the "Albatross"; *Centroscyllium ornatum* (Alcock), from 285 to 690 fathoms in the Bay of Bengal and the Arabian Sea; *Lepidorhinus foliaceus* Günther, from 345 fathoms off Japan, taken by the "Challenger," and from 960 fathoms in the Philippine Archipelago, taken by the "Albatross."

[2] It was made the type of a new genus and called *Squaliolus laticaudus* by Smith & Radcliffe (see page 351).

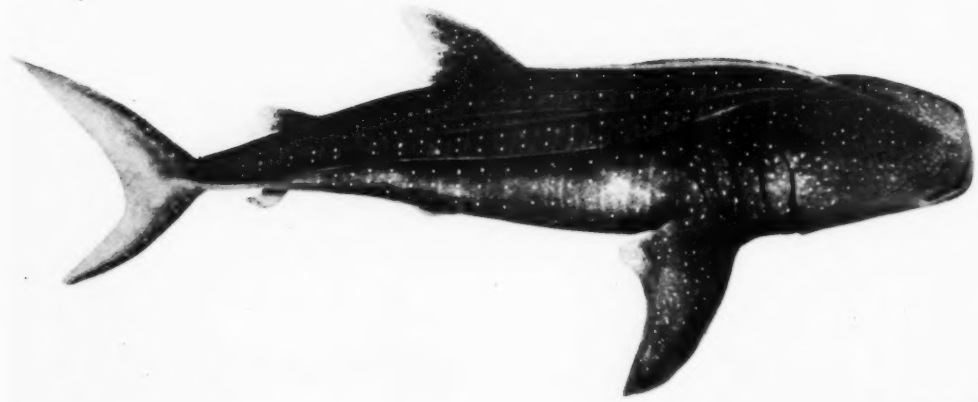
[1] The Pacific coast form is *S. sucklii* (Girard).



DUSKY SHARK AND WHALE SHARK

The dusky shark (*Carcharhinus obscurus*) (upper picture) is common in summer along the middle Atlantic coast. It attains a length of fourteen feet, but is not dangerous. *From unpublished sketch by Charles R. Knight*

This whale shark (*Rhinodon typicus*) (lower picture) was taken in Florida in 1912, was grotesquely stuffed, as shown in the cut, and exhibited as a marvel. About forty feet long, it belongs to a species dangerous only on account of its bulk



From type drawing in A. Smith's Ill. Zoöl. S. Africa

This representation of the whale shark (*Rhinodon typicus*) gives a good idea of its form and markings but not of its size, for it is the largest of all existing fishes, attaining a length of from fifty to seventy feet. It is the tropical counterpart of the basking shark, feeding upon small fishes and other marine creatures which it strains from the water with its gill rakers. It is harmless to man unless attacked and then chiefly dangerous for its power in towing or overturning a boat

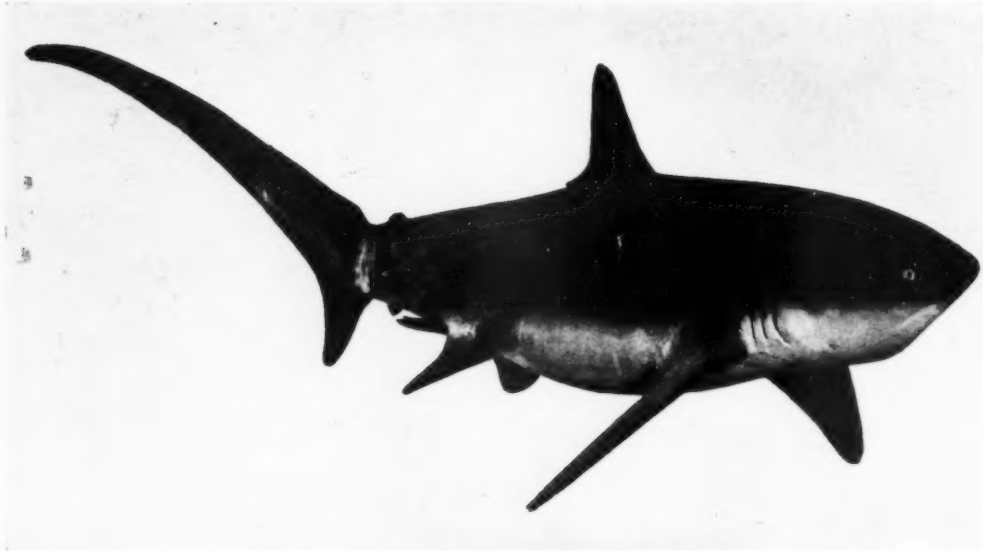


Photo of cast in American Museum of Natural History

The thrasher or swingle-tail (*Vulpecula marina*) is distinguished from all other sharks by the astonishing length of its tail, which may be six or seven feet in a large specimen. It is a fish feeder, circling around a school of fish, using its tail to whip the water and keep them together until the moment of engulfment. A pair of thrashers sometimes fish together in this manner. The theory that thrashers kill their prey by lashing it with the tail is not borne out by observation. (See page 347 for description of thrasher)

north of Cape Cod. Coming along our shores in schools containing untold millions, and one school following another often with slight intermission, these fishes do immense damage for fishermen by devouring or mutilating the food fish taken in the gill nets, by eating the bait and the line-caught fish, by chewing and tearing nets and lines, by filling pound nets to the exclusion of other fish, and by devouring lobsters in and out of the lobster pots. When the schools of dogfish appear, the fishermen must abandon their efforts, and the loss of fish and apparatus is thus supplemented by loss of time. There have been seasons when the damage to the fisheries of the New England coast by this one species has been fully a million dollars. The loss is accentuated by failure of the fishermen to make any use whatever of the dogfish because of the lack of a market demand in the United States, notwithstanding that the fish is wholesome and nutritious and is very extensively eaten in western and southern Europe.

One of the great American needs at the present time is the shark-eating man. All sharks of sufficient size have a food value, and in many parts of the world sharks are regularly fished for and used for human consumption. In the United States the utilization of sharks has been negligible for several reasons; notably because of the abundance and variety of other food fish, and because of our ignorance of their food value, and our deep-seated prejudice on account of their unsavory reputation as consumers of the most promiscuous materials, including living and dead human beings. It may prove to have been a very unfortunate coincidence that the killing of Americans by sharks should have come at the very time when the Bureau of Fisheries was inaugurating a campaign to induce the wholesale consumption by Americans of one of the most destructive, though least dangerous, species of sharks. It remains to be seen whether, in spite of this untimely handicap, a movement in the interest of fishermen and fish consumers, based on indisputable economic facts, will not succeed.

The Congress of the United States, at the recent session, appropriated $25,000 to enable the Commissioner of Fisheries to conduct investigations and experiments for the purpose of ameliorating the damage to the fisheries done by the dogfish and other predacious fishes. The act is aimed primarily at the spiny dogfish, and the task before the Bureau of Fisheries is to convert an unmitigated nuisance into a valuable asset.

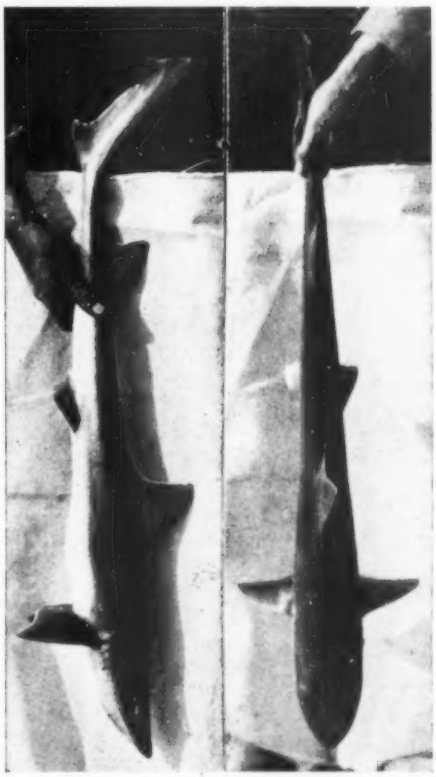


Photo by J. T. Nichols

The abundant and destructive "smooth dogfish" (*Galeorhinus laevis*)

SEA MUSSEL COMMUNITY ON MARTHA'S VINEYARD

The sea mussel community in Menemsha Pond, Martha's Vineyard, Massachusetts, covers an area of ten acres and averages seven hundred and fifty shellfish to the square yard. The total population of the community is about thirty-six millions. Each mussel is attached firmly to the stones underneath and to its immediate neighbors, so that it cannot be carried away by tide or waves. Such mussel beds are found commonly in sheltered bays along the coasts of Massachusetts, Rhode Island, Long Island and New Jersey

A Community of Sea Mussels

ONE OF THE GREATEST ORGANIZATIONS IN NATURE FOR MAKING FLESH FOOD BY A SHORT AND RAPID PROCESS —— AND IN PALATABILITY SEA MUSSELS RANK SECOND TO NO KNOWN SHELLFISH

By IRVING A. FIELD

Assistant Professor of Biology in Clark College, Worcester, Massachusetts

VISITORS at the seashore are often struck with wonder when the receding tide exposes to view vast areas of the sea bottom completely covered with mussels. The favorite habitat of these clamlike mollusks is where the water is slightly brackish, in shallow protected bays and estuaries, on a bottom of mud rich in diatoms and other microscopic plants and covered more or less with stones or other solid objects. The latter are necessary to serve as a foundation to which the mussels may attach themselves firmly by a series of strong threads called the "byssus." These threads not only bind the mussels to foreign objects but also to one another, so that it very often occurs that members of a community are woven together like a carpet. From such a bed it is possible to tear loose extensive portions and roll them up as one would a rug.

Sea mussel beds may be encountered along the seacoast almost anywhere in the northern half of the Northern Hemisphere. On our Atlantic coast they occur in abundance in the shallow sheltered bays along the coasts of New Jersey, Long Island, Rhode Island and Massachusetts. The beds thrive well in shallow water where they are not exposed long at low tide. They grow much better, however, in the deeper waters where they are not influenced by extreme changes of temperature, frost or ice.

An interesting community of mussels which has been under my observation for the past six years is in Menemsha Pond on Martha's Vineyard, Massachusetts, not far from the famous Gay Head Cliffs. The pond covers somewhat less than a square mile and is connected with Vineyard Sound by Menemsha Creek, which is a broad deep channel about half a mile long. This creek allows the passage of a considerable volume of water in a short time so that the rise and fall of the water in the pond between tides amounts to about three feet. The density of the water is very little less than that of pure sea water, owing to the fact that very little fresh water enters the pond. Much of the bottom of the pond is muddy and supports a luxuriant growth of eelgrass (*Zostera marina*). As the eelgrass dies and disintegrates from year to year it contributes to the organic matter of the bottom and furnishes shelter and food for myriads of microscopic plants and animals, chiefly diatoms and Protozoa. Where the pond converges into the creek there is a great bar, ten acres or more in extent, composed of mud, sand and gravel, much of which is exposed at extreme low tide. Over it the tidal currents sweep vast quantities of microscopic organisms, and fine particles of dead organic matter derived from the pond and from the open ocean. Seven years ago this bar was a clam flat with no mussels in the vicinity, but during the following summer the tide carried up Menemsha Creek billions of minute

free-swimming mussel embryos that fastened themselves to the pebbles and grains of sand at the mouth of the pond. As if by magic the broad expanse of white desert sand was covered with a blue-black carpet of sea mussels in a single season. I counted as many as one thousand of these shellfish to the square yard and estimated that there were approximately ten thousand bushels to the acre.

object. This movement is followed by a relaxation of the circular muscles and the contraction of a set of longitudinal muscles that result in drawing the animal forward. Young mussels are much more active in moving about than are adults. Some specimens about a quarter of an inch long were lined up for a race over a measured piece of ground and were observed to make a speed record of one inch per minute. The young

River bottom at Sandwich, Massachusetts, when exposed at low tide. Female mussels lay annually some ten to fifteen million eggs each. The minute free-swimming embryos may enter a salt water stream, attach themselves to the rocks of the bottom, and in a single season convert the atoms of dead organic matter of the river mud and the numberless millions of microscopically small plants and animals of this mud into a vast bulk of flesh food

The ability of the sea mussel to exist under such crowded conditions depends upon its power of movement, means of anchoring itself firmly, and the wonderful efficiency with which it is capable of collecting food. Locomotion is accomplished by means of a muscular strap-shaped foot equipped with a sucker on the end. By contraction of a set of circular muscles the foot is thrust out and the sucker attached to some solid

shellfish can creep up perpendicular surfaces, such as are presented by rocks and wharf piles, as readily as they move on a horizontal plane. Their power of locomotion under difficult conditions is sufficient moreover to enable them to do greater feats than to climb up vertical walls, for on reaching the surface of the water when it is perfectly quiet I have seen them, like the pond snail, creep out on the under side of the superficial film.

The habit of the sea mussel is to lie with the beak buried in the sand, or mud, and with the syphon end, through which the food current enters, projecting into the water above. The waving cilia attached to the gills of the mussel cause a continual circulation of the water, sifting from it the microscopic organisms on which the mussel feeds

When the community is overcrowded, it is necessary for the mussels to stand on their heads to prevent the individual food-bearing currents from being cut off, but there is usually no lack of food even under the most crowded conditions, for the minute water plants which form the staple supply increase so rapidly that, unreduced, they would fill the ocean solid in less than a week

SOME ASSOCIATES OF THE SEA MUSSELS

Sea anemones, moss animals, serpulas and barnacles are clinging friends of the sea mussel

The sea mussel (*Mytilus edulis*) with foot extended in the act of attaching a byssus thread. At the base of the foot may be seen the byssus organ projecting between the valves and also the byssus which anchors the animal firmly to the rocks by scores of tenacious fibers

The ability to creep about thus, readily enables the mussel to migrate from unfavorable surroundings and locate in the most advantageous situations.

When the ideal position is found, the mussel secretes a number of tough elastic threads forming the byssus, which firmly anchors it in place.[1] A single thread may be formed and attached in three minutes but usually more than double that time is taken. As many as eighteen threads have been formed by a mussel under observation during a period of four hours, and as many as one hundred of these threads may be found anchoring the mollusk firmly to its neighbors or to other points of attachment. In a mussel community all the members in contact with one another are firmly woven together by means of the byssal threads. Under this condition powerful waves, swift currents and even ice have little effect on the firmly united community.

When we speak of the gills of an animal we usually think of them as respiratory organs but in the case of the mussel the

[1] The byssus is composed of three parts; a stalk, a thread, and an end plate which securely cements the thread to some solid object. Each of these is secreted by a separate gland in the foot. The stalk comes from a large gland situated in the base of the foot. Microscopic sections show that it is composed of many glandular membranes that hang down in a byssus cavity like a series of curtains. They secrete a sticky fluid that fills the cavity and is forced out at the base through a round aperture which molds it into the form of a rod. Contact with sea water causes this sticky fluid to become as firm and tough as horn.

The secretion that forms the byssus thread arises from glands in the foot which discharge into a ventral groove running the entire length of the foot where it is molded into shape and hardened by contact with the sea water.

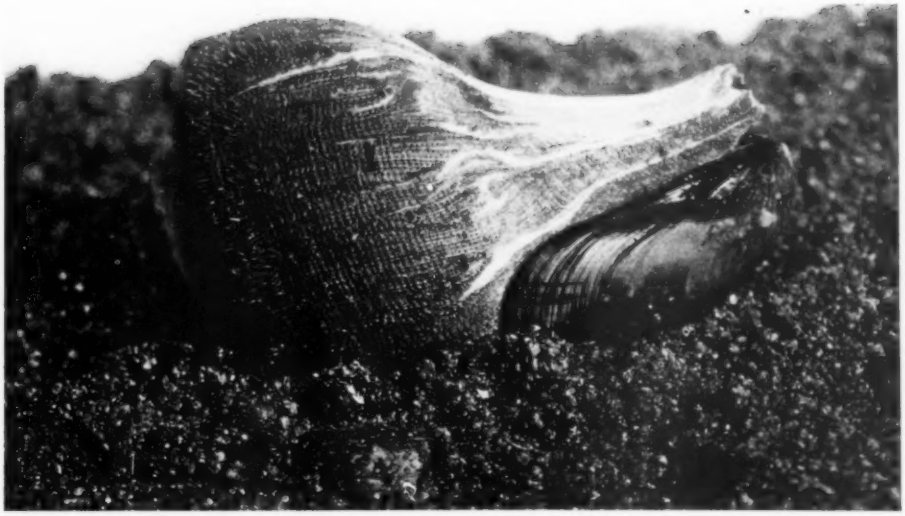
The attachment plate is formed from secretions produced in the upper part and end of the foot by glands that discharge into the hollow depression near the tip on the under side.

breathing function of the gills is merely secondary. The gills have developed great brushes of cilia and have been modified to serve primarily in the collection of food. Rapid movement of the cilia causes a continual flow of water, from which the cilia sift out enormous numbers of diatoms, Protozoa, and minute floating particles of dead organic matter, which are conveyed to the mouth through a special food groove located on the lower edge of the gills. The process goes on day and night and the food supply is practically inexhaustible. Even though the members of a community in a favorable situation are packed together as closely as sardines in a box, there is usually food enough for all as long as the avenue to the inhalant canal remains unobstructed. In very crowded portions of a community it is often necessary for the members to stand on their heads in order that the individual food streams be not impeded.

Photomicrograph of the main byssus gland, showing the glandular membranes that hang down in the byssus cavity like a series of curtains. The sticky secretion is forced out through the aperture at the base where, on coming in contact with the sea water, it hardens into a tough rod

The food supply of the mussel community is a subject of great interest because it represents the ultimate food basis of all marine animals. Decaying eelgrass forms minute particles called "detritus," that contain nutritive compounds related to starch, which the mussel utilizes to some extent, but the most important source of its food is the group of plants constituting the diatoms. They represent the energy of sunshine combined with air, water, and salts in a form available for food. In their composition the three food principles, protein, carbohydrate, and fat are present and they are built up at a rate that is astonishing and beyond our powers of comprehension. Submerged in a medium where they are supplied with unlimited quantities of water, oxygen, and mineral salts, and with sunshine, the diatoms are able to multiply and grow at a rate that puts the proverbial mustard seed to shame. As the late Professor Brooks has rigorously demonstrated, one of these microscopic organisms under favorable conditions is capable of filling the ocean solid in less than a week, if all its progeny were to live and keep on multiplying at the maximum rate during that period. This is a stupendous fact and it must be comprehended before one can understand life in the sea. It explains why such enormous communities of shellfish can be supported on a limited area of the sea's floor.

Unlimited food supply is coupled with almost unlimited powers of reproduction. In the sea mussel we find the strange condition in which practically the whole body becomes a storehouse



The conch enters the shell of a mussel without waiting for any invitation, tears out the flesh of its victim and devours it with relish. A host of enemies feed upon the mussel and would seem to foreshadow its extinction were it not for its wonderful powers of reproduction and the inexhaustibility of its food supply

The starfish is the archenemy. Enormous numbers — which no one has yet attempted to estimate — of the mussels are victims of voracious armies of starfish, that march back and forth across the mussel beds and up and down wharf piles where these molluscks grow

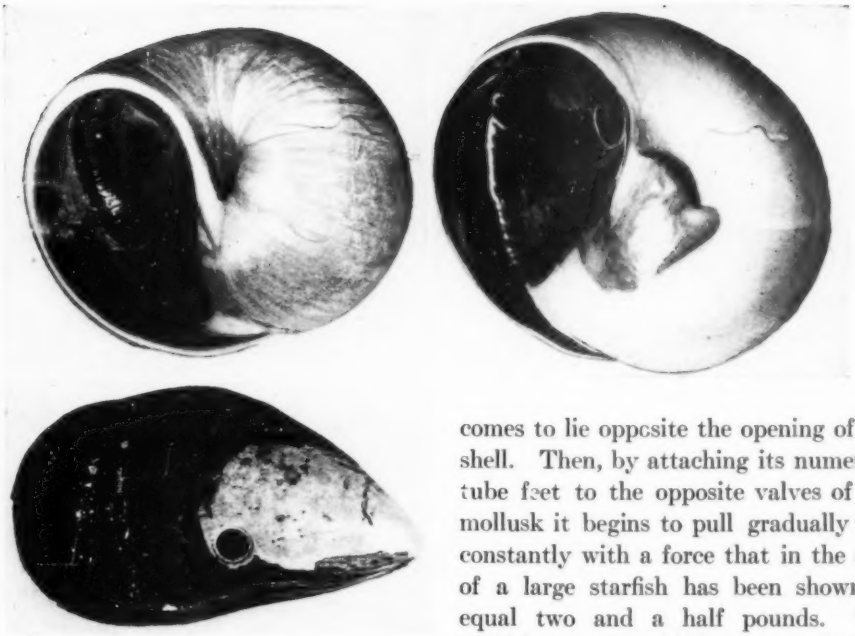
for reproductive elements. Each female lays annually from ten million to fifteen million eggs. In the Menemsha mussel community there are some thirty-six million individuals. If half the number is reckoned as females and we assume each one to lay an average of ten million eggs, we should have resulting 18,000,000 times 10,000,000 eggs which

The oyster drill (above) likes mussels better than oysters. Its toll of victims ranks second to that of the starfish only

The dog whelk (below) is very fond of mussel flesh and may become an able assistant to the oyster drill in exterminating a colony of mussels

is 180,000,000,000,000 — which represents the possible number of offspring that can be produced in one year by the Menemsha mussel community. The eggs develop at a phenomenal rate, producing free-swimming embryos within five hours after fertilization. At the end of three to five days the shell is formed and the young mussels that are fortunate enough to have escaped the jaws of numerous voracious beasts of prey and to have been carried by the tidal currents to favorable situations, now settle on stones, seaweeds and other solid objects, where, after creeping about for a time, they attach themselves by means of the byssus and start a new colony. Under favorable conditions they grow rapidly, the growth often amounting to more than an inch a year for the first two or three years. After that there is a rapid decline in the rate of growth.

Associated with the mussel community, there are usually found numerous plants and animals that add much to it in the way of beauty and general interest. Rockweed often gracefully overhangs portions of the bed and sometimes ribbon-like streamers or branching filaments of exquisitely colored red, pink, green, and brown algæ attached to the shellfish, wave to and fro in the water. Beautiful bunches of the delicate pink hydroids, which look like plants but in reality are animals, may be seen clinging to the shells, while sea squirts, sea anemones, sea urchins, sea pork, sponges, corals, barnacles, boat shells and moss animals live in friendly relation with the whole community. This relationship has been most successfully demonstrated in the mussel group on exhibition at the American Museum of Natural History. Curious looking worms of various sorts and often of brilliant colors burrow beneath and between the mollusks, and on their shells the serpulids often construct tortuous limy tubes. The little periwinkle, *Littorina*, is nearly always preesnt on the beds in great numbers, especially when eelgrass and algæ are growing there in abundance. Green crabs, rock crabs, spider crabs, and king crabs flit back and forth over the community, busily engaged in the mussel scavenger service. Peeking out from



The cockles bore holes through the mussel shell, and then, inserting the proboscis, eat the mussel alive. (Cockle at left, *Lunatia heros;* Cockle at right, *Neverita duplicata*)

a mussel you will often discover a little crab, *Pinnotheres maculatum*, which is a first cousin to the little crab sometimes found in the dish of oyster stew. It has been asserted that this little fellow hides here to escape his enemies and when the current happens to bring morsels of food close to the hiding place the crab rushes out, seizes and carries them in, where he tears them to pieces and shares the meal with the mussel in return for the protection received. The tale is interesting but lacks confirmation.

Aside from these friendly dwellers in the mussel community there are numerous predacious species that pay unwelcome visits. Of these the starfish is the archfiend of them all, for to the starfish "palate" there is nothing like mussel flesh and his appetite for it is never satisfied. The starfish seizes the mollusk in such a position that its mouth comes to lie opposite the opening of the shell. Then, by attaching its numerous tube feet to the opposite valves of the mollusk it begins to pull gradually and constantly with a force that in the case of a large starfish has been shown to equal two and a half pounds. The starfish rests by shifting its work from one set of muscles to another, while the plucky mussel, relying on the single muscle that holds the two parts of its shell together, becomes exhausted and succumbs to the weaker but tireless pull of the enemy. When the valves open, the starfish turns its stomach inside out, envelops the soft parts of the prey with it and digests them outside its own body. As soon as this is accomplished the starfish draws its stomach within its body again and immediately starts in search of another victim. Regular armies of starfish march back and forth across the mussel beds and up and down wharf piles and rocks where the mollusks grow, devouring them at a rate which no one has yet attempted to estimate.

The conchs or winkles, *Busycon carica* and *B. canaliculata*, also have a keen appetite for the tender *Mytilus*. The manner of attack is to crawl on top of the victim and patiently wait for the valves to open, when the conch thrusts its own shell between the valves of the prey, introduces its proboscis and with

the radula tears out the flesh of its victim.

The cockles, *Neverita duplicata* and *Lunatia heros*, are occasionally very destructive enemies of the sea mussel. They are armed with rasping tongues that bear chitin-like teeth, with which they are able to bore holes about one-fifth of an inch in diameter through the mussel's shell. They then insert a proboscis through the opening and literally devour the helpless animal alive.

Closely related to the cockles in habit are the oyster drill, *Urosalpinx cinerea*, and the dog whelk, *Purpura lapillus*. They drill smaller holes through the shell than do the cockles but feed on the living animal in the same manner. Being more abundant, however, they are far more destructive. In one case I saw a small mussel community completely destroyed by them.

Fishes of various species are ravenous feeders on mussels. Killifish, cunners, scup and tautog greedily strip them from the wharf piles and from the beds. Squeteague, flounders, codfish and eels also devour them in great quantities. The fact that mussels constitute the best bait known, next to squid, indicates how they rank as food for fishes.

The enemies of the mussel are not limited to the water in which it lives, for from the air above herring gulls, night herons, crows and wild ducks descend upon the beds greedily to eat the young shellfish. The common gray rat and the muskrat pay frequent visits for the same purpose. Seals, especially young ones, feed largely upon mussels, but the mammal which uses them most extensively is the walrus, for which they constitute the sole food. The walrus crushes the shellfish in its mouth, throws out the shell and swallows the fleshy parts.

The struggle for existence against such a host of enemies would seem to foreshadow extinction; but when we weigh against these destructive forces the wonderful powers of reproduction, and the inexhaustible food supply that can be utilized by the mussel, it is easy to understand why this tremendous drain on the mussel population is having no perceptible effect. Indeed competition in the community itself probably results in a greater mortality than is caused by all its enemies combined. Enormous numbers of mussels are being smothered to death daily by their own offspring which in the struggle for existence bury their parents beneath themselves.

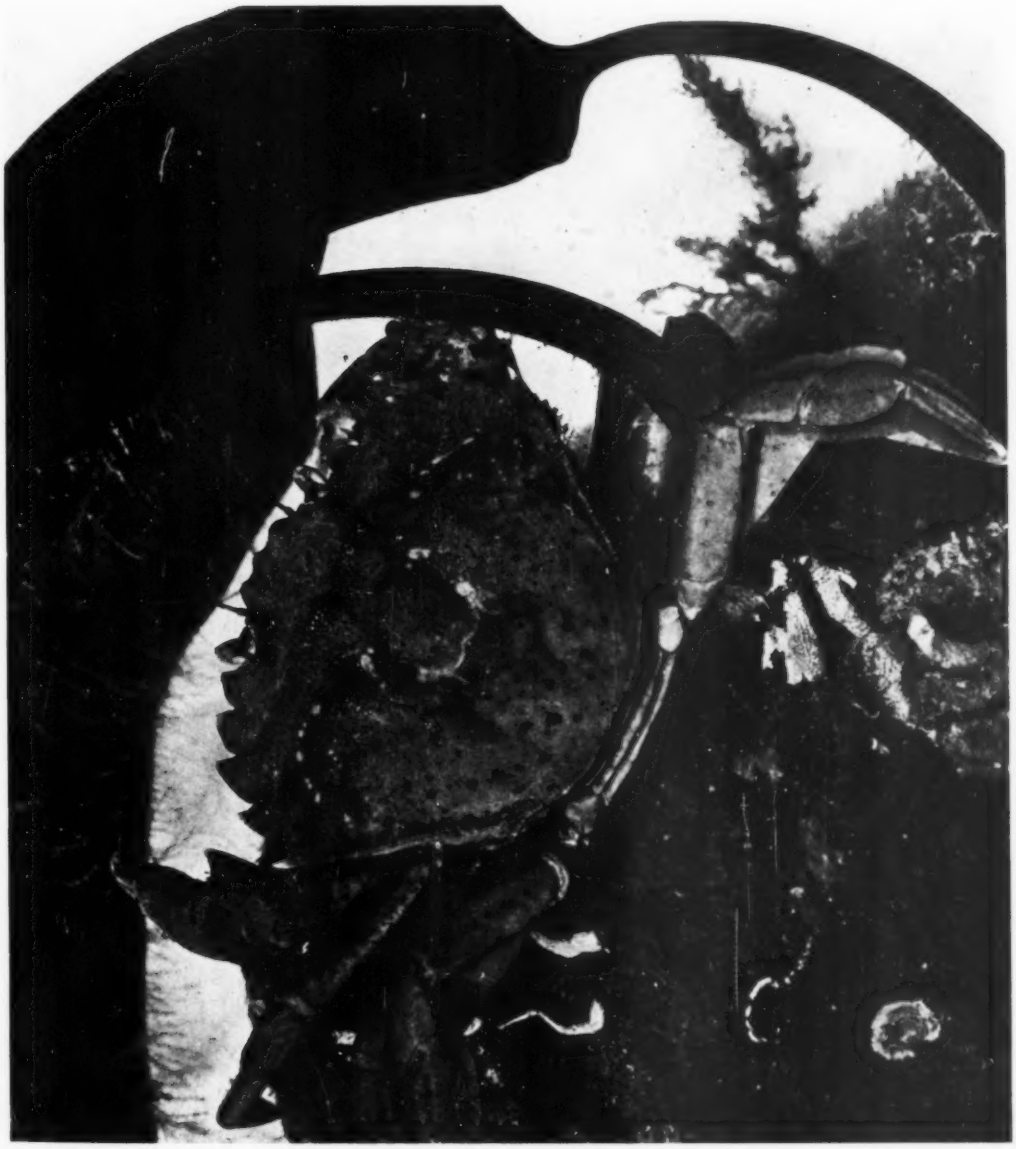
From an economic standpoint the mussel community should bear a more important relation to man as a source of food supply.[1] The mussel collects the elements which form the ultimate food basis of marine animals, reconstructs them into mussel flesh and reproduces countless individuals, and they in turn become subsistence for other animals. The flesh of the sea mussel is actually the most valuable in nutritive principles of all shellfish and in palatability and digestibility it ranks second to none. As a nation we have been wasting one of our great national resources by failing to make more extensive use of the vast quantities of sea mussels annually produced along our shores. The estimate is easily within the limits of probability that more than twenty million pounds of this shellfish on our Atlantic Coast are available for the market annually.

In the light of our present knowledge it is proper to say when viewing a shoal of mussels, "There is one of the greatest organizations in nature for making flesh food by a short and rapid process." Surely the humble mussel is fulfilling a benevolent mission in this world.

[1] Sea Mussels, What They Are, and How to Cook Them. Economic Circular No. 12 is a publication that may be obtained free on request from the Commissioner of Fisheries, Washington, D. C.

PHOTOGRAPHS FROM THE BEACHES AND SHALLOW WATERS OF THE MASSACHUSETTS COAST DURING THE MONTH OF SEPTEMBER

BY MARY CYNTHIA DICKERSON



ADVENTUROUS EXPLORATION AT HIGH TIDE

The green crab (*Carcinides mænas*) is a reckless adventurer and makes a bold stand when brought to bay. In the water about the rocks where he lives, schools of small fish play when the tide is high, and Ctenophores gleam in the sun. Here a school of young squid scatters as a large fish comes up from hiding and reduces its ranks by one

TIDE ROWS ON A SANDY BEACH

Tide and wave have torn the eelgrass from some sheltered muddy cove. Here it lies, bleached and dry with long white banners whipping in the wind. With it are fine red seaweeds, bleached to exquisite purple traceries of design, "scallop" shells and quahog half buried in the sand, tests of spider crabs and of "sand dollars," the black egg cases of the skate, broken strings of whelk egg capsules—many objects that, although themselves empty and dead, yet tell a story of multitudinous life. The molted coat of a lady crab beats in the surf, yielding every joint as though alive—up onto the sand, back into the sea. It will finally be stranded and lie with the others, bleached white in the sun

be stranded and lie with the others, bleached white in the sun

AT HOME IN SUNLIT WATERS

The immense claws of the lady crab (*Ovalipes oceliatus*) are expert in catching small fishes—which are then turned head toward the mouth and disposed of. A medium-sized killifish can be eaten in less than a minute by the watch. The lady crab burrows by means of its oarlike back flippers. They cut down into the sand, are turned and lifted, bringing up a load, flash down into the sand again, are turned and lifted. This action quickly scoops out the burrow, into which the crab comfortably settles. During storms the lady crab buries itself deep in the sand for protection from the breakers

DOWN IN GARDENS OF THE SEA

"Sea anemones" live in shaded ocean nooks. As beautiful as flowers, they are really voracious animals, with the rose, olive, or yellow tentacles which encircle their mouths armed with poison to aid in the capture of crab, mollusk, or fish. In the daytime they may seem to move as little as flowers, but at night they are active, and may even change their location. One with a column but an inch high may assume, as we watch, a stature of four or more inches, with the ruffle of tentacles stretching far above that; or, if alarmed, the whole animal may quickly contract to a flattened jelly-like mass less than a half-inch high

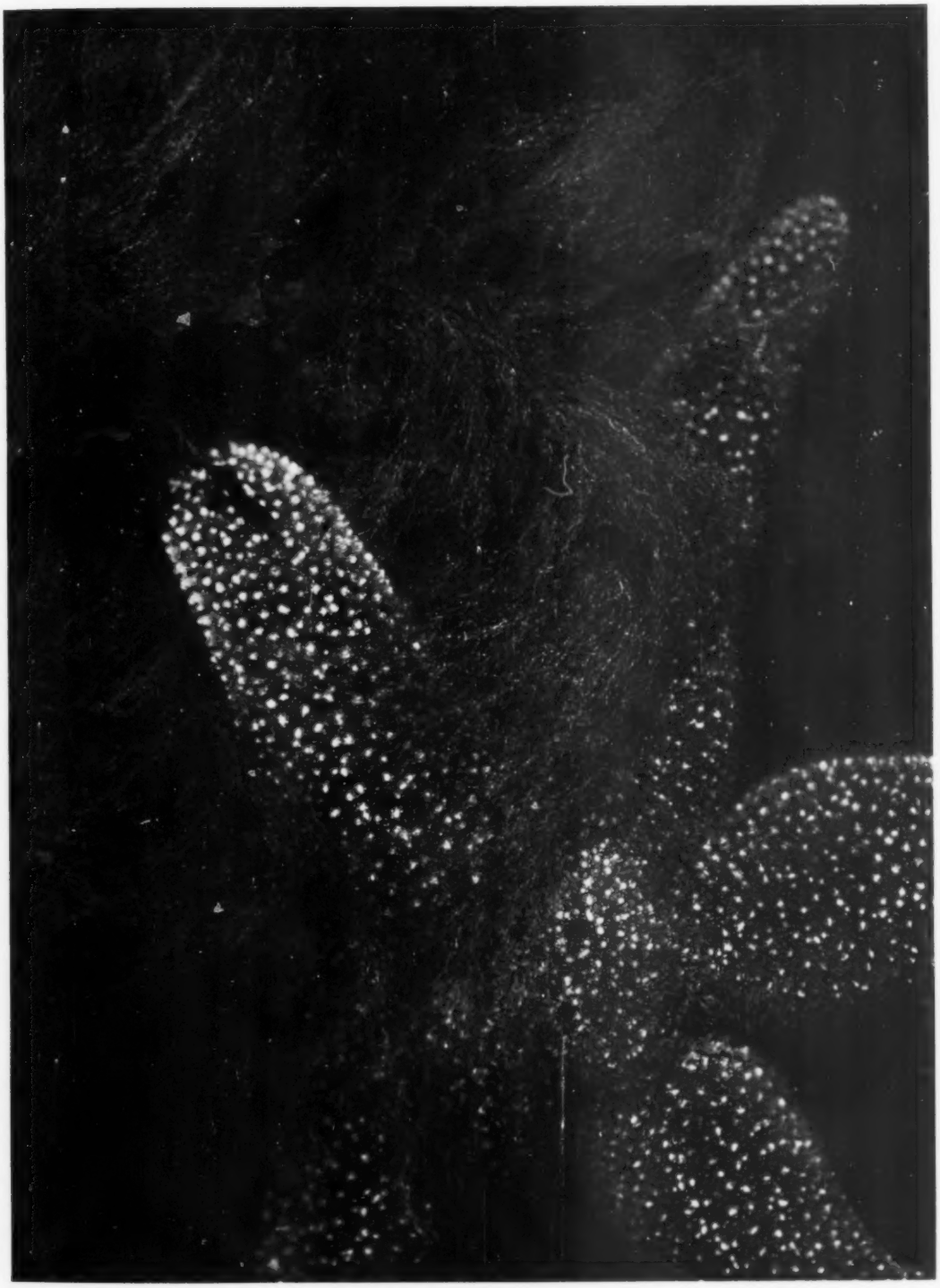
AS WONDERFUL IN COLOR AS OUR GARDENS OF THE LAND

Stars of this small species (*Cribrella sanguinolenta*, seldom more than two inches across) usually vary in color from brick-red to orange with vivid yellow on the under side. They travel slowly by means of their many "tube feet."

In the warm waters off a sheltered coast, activity among sea animals may continue in the fall; on exposed shores most species are in hiding under sand or rocks, and there may be vast destruction of life as storms hurl the sea into spray on the rocks and pound it high on the sand. Such storms may make conquest of even deep-water species to cast them upon the land

SILENCE AND SPACE

There may be little sign of life on the sandy shore after a storm. Animals are buried under rocks or sand. For hours the surf has dashed high on the beach, dropping back to leave a smooth sloping floor. There are delta-like channels in the hard-packed sand where water grooved its way to the sea



A COMMON STARFISH

Starfish wander continually among the waving seaweeds of rocks and wharves in search of delectable sea mussels and other mollusks. They breathe the air from the water through multitudes of fingerlike tentacles (seen in the photograph everywhere between the white spines), which are protected by minute snapping jaws (showing as white dots among the tentacles). In early September the sand at the water's edge is ornamented with the dark symmetrical forms of young stars one-half inch across (the large adult *Asterias forbesii* may measure twelve to fifteen inches)

FIDDLER CRAB "EATING SAND"

The large pellets of sand (at the right) are "armfuls" carried up from below in excavating his burrow; the small pellets are "mouthfuls" of sand from which he has eaten the organic matter. An immense village of fiddlers (*Uca pugilator*) with all residents sitting outside their doorways "eating sand" is a remarkable sight. Down go the small claws to the sand, up to the mouths, down again and up, down and up, as fast as possible. Males do not use the large claw in eating, but hold it aloft as in defense. Females usually use the two claws, both of which are small, but may use only one, ludicrously holding the other little one aloft in the grand manner of the males. Young fiddlers are so minute (1¼ mm.) that they suggest moving sand grains. Hungry crows dig out the fiddler burrows

in the grand manner of the males. Young fiddlers are so minute (1¼ mm.) that they suggest moving sand grains. Hungry crows dig out the fiddler burrows

ONLY A TIDE-MOVED MASS OF HYDROID?

The spider crab (*Libinia dubia*) cannot fight, run away, or burrow rapidly, but he has a well-developed instinct for disguising himself—transplanting hydroids, sponge, *Bugula*, or seaweed to his head, back, and legs. If he moves to a new place, within ten minutes he has cleared away the old garden and decorated himself anew. He looks very silly measuring off and cutting pieces, putting them stem end to his mouth for a bit of cement, lifting them into position for planting, and wiggling them about until the cement holds or they catch in the fine hooked hairs that cover his upper surface

SAND WAVES CARVED BY AN EBB TIDE

On extended sandy beaches the waves cut deep parallel terraces in the wet sand. Trails of "periwinkles" (*Littorina litorea*) cross the sand waves. Sometimes "periwinkle" processions slowly move along in a single groove, heads and black "horns" all directed toward the sea. Other trails like braided patterns in the sand show where stranded hermit crabs scurried to water when their small pools sank into the sand. Many crabs, worms, and mollusks are burrowed under the sand

DETAIL OF BEACH LEFT DRY BY THE TIDE

Motionless rockweed measures its length among the stones. Purple or orange starfish lie flattened and awry. "Periwinkles" are congregated in a band above lowest water waiting for the return of the tide. "Periwinkles" are often prisoners in their shells, for hermit crabs live among them, who grab them up, turn them about, and pick at them with sharp claws if they attempt to come out. Seaweeds bearding the stones at the water's edge are swept roughly in and out, but in pools sheltered from the waves by some high rock, varied colors of seaweed, crab, mollusk, anemone, and hydroid spread out in oriental mosaic—browns and yellows, red, green, olive

"MOSS ANIMALS" OF THE SEA

Eelgrass and the coarser seaweeds are everywhere festooned with yellow sprays of moss animals (*Bugula turrita*)—large branching tufts of them, sometimes a foot long. Growing fast to seaweeds, looking like seaweed, they travel with storm and tide and are often tossed on the beach too high to be carried out again until the whole colony—thousands of minute animals—is beached and dead. The beach is a vast sarcophagus of the sea. One can never tell what forms, rare or common, may appear there, today or tomorrow, and the fascinating search takes one to the doorway of one of the fields of biological science most bewildering in its wealth of species and their interrelationships

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The Laws of Species Forming[1]

By DAVID STARR JORDAN

SOME years ago I ventured the statement that taking any given species of animal, the nearest related form would not be found along with it, nor at a great distance, but on the other side of some barrier which prevented intermingling.

This fact is almost self-evident, as far as the higher animals are concerned. We very rarely have any difficulty in determining the separate species in any given region. For this reason those naturalists who read the proposition have accepted it. Dr. J. A. Allen, one of the highest authorities on birds, went a little further and named it "Jordan's Law." But it existed in the nature of things before it was mine, and I can be credited with its ownership only for the sake of convenience in the discussion of the many ways in which life manages itself, which we call natural "laws."

This law goes back to the origin of diversity in life, which, among other ways, shows itself in what we call species. A species of animal or plant is one of the many kinds into which organisms are divided. It has no objective, definition, or criterion. It is merely one particular crowd or mass of living things, giving rise by processes of reproduction to a succession of similar organisms, not all alike but nearly alike, so that for ordinary scientific purposes one name may serve for all.

If however, its range be broken by a barrier of some sort, so that intermingling and interbreeding are no longer possible, the mass will be separated. Those on one side of the barrier will gradually throw stress on one sort of characters, those on the other side on something else. The original stock may average different or the two groups may be subjected to different forms of selection, or the stress of a different environment, and the final result will be different. If these forms have sufficient sharpness of definition we call them different "species," even though the differences be small. If however, the separation be imperfect, so that intermediate forms lie along the road, we call them "subspecies." Inside every species or subspecies we find a differing range of individual variation. As a rule those variants which arise in the midst of a species are soon lost, unless they can be isolated or segregated in some way — and this rarely occurs in nature. Great differences can be produced and emphasized in the domestication of many species of animals or plants. This is called artificial selection, but it depends not only on selection but also on the segregation or isolation of the product. The races of dogs would never have arisen if the animals chosen to be friends of man, had continuously bred freely with the mass of wolves.

In discussing the origin of species, we premise first that species in nature exist — but not as closed categories. They arise through the perpetuation by heredity of variants which are cut off from the original species by some sort of barrier of land or sea, of temperature or climate, of food or enemies. Once cut off, their inadaptive excrescences are pared away by selection, and at last the new species, as well as the old, comes to fit its environment as the river fits its bed.

[1] Abstract of address before the American Association for the Advancement of Science, San Diego, California, August 10, 1916.

As regards the vertebrate animals this is the origin of species. We can prove it in thousands of cases, as surely as we can prove anything by experiment when nature lays down its conditions. While now and then "mutations" or discontinuous variations occur, especially in domestic races of mixed origin, I do not know of a single species of vertebrate animal which could even hypothetically be supposed to have originated from a mutation.

Among the different races or variants of birds, none is recognized by name, or as having permanence, by competent ornithologists, unless these variants have a geographical basis. Subspecies are therefore geographical races, and these are the stuff that species are made of. The word geography should not be construed too literally; one does not need to go far up a mountain side, or into the depths of the sea, to find a condition of things radically different from those at sea level, on land, or in the ocean.

I have thus far referred only to vertebrate animals because I know these best, and because their intensified life makes their relations to one another and to the environment sharply defined; but I know that exactly the same rules apply to the invertebrates and to plants in their degree. Among plants the influence of some features of the environment are very great, as soil, moisture, and temperature; while barriers are often passed more easily than with most animals. Some plants moreover are self-fertilized, and therefore really isolated from their kind, although growing in the same neighborhood. There are more cases of nearly related species growing close together among plants than among animals. Yet even among the higher vertebrates there occur some of these cases — reinvasion perhaps on the part of the separated and modified forms. These however, are not common enough to affect the main proposition, and each case should be studied on its merits. The real point at issue is this: Varieties, or incipient species, blend with the main group unless kept separate in the breeding season. Migratory birds and fishes may mingle outside the breeding season without likelihood of crossing and thus of losing distinctive characters.

In the discussion of the "Law of Geminate Species," I have approached the same problem from another side. Geminate, or twin, species are forms substantially alike in characters and habit, but separated by barriers which hold them permanently apart. These abound in botany — roses, maples, plane trees, brambles, Clintonia, Trientalis, Trillium — they can be found in almost every widespread genus. They are relatively equally numerous among birds and fishes. On the two sides of the Isthmus of Panama there are more than a hundred such pairs of species of fishes, separated from each other since the Miocene. It needs no search to find them among insects or mollusks. The origin of such twin pairs is obvious, and it is plainly not due to mutations after the fashion of those described in a hybrid evening primrose by Hugo de Vries.

If there were one-thousandth part of the evidence for the origin of species by mutation that is shown for the origin by separation, the theory of de Vries would have standing in science. But to show that species arise in general through separation by barriers is not to exclude any other influence whatever. We know of no species however, which is not the product of internal influences — heredity with variation — modified by the external limitations arising from selection and isolation. Whatever else may be a factor in the formation of species in nature or in domestication, from these four we can never escape — heredity, variation, selection, and segregation.

The Loom in the New World

By M. D. C. CRAWFORD

THERE are three distinct types of loom in the New World. On the Northwest Coast is found the single-barred, warp-weight type of the Haida Indian tribe, commonly referred to as the Chilkat loom. This is unquestionably a very early form and closely related to the type used in making matting. Its distribution is very curious. Among the interesting objects discovered in the neolithic Swiss lake villages are many clay and stone weights which indicate that this kind of loom was in use in the dim antiquity of European history. In an old saga the journey to the rim of the earth of one of the mythical heroes is described. He beheld there three wrinkled old furies weaving into a gruesome fabric the fates of man. The warps were sinews of heroes, the wefts were entrails, and the loom weights were skulls. Hideous as this description is, it nevertheless indicates perfectly the early Scandinavian types of loom. A much more pleasing record appears on a famous Greek vase. Here Penelope is shown weaving the famous fabric she never finished. In all essentials the loom is the same as the modern Chilkat type.

Among the Ojibway and Menominee Indians of today, there still remains a trace of what in former times must have been a very extensive bag-weaving art. The American Museum collections contain many handsome examples, which show high artistic and technical skill. The form of loom is apparently related to the one just described

Aztec mother teaching her daughter to spin.— [From native picture writing reproduced in Kingsborough's famous *Antiquities of Mexico.*] In the upper picture the right hand holds a bundle of fiber, and the left a spindle, on which the yarn is wound. The spindle rests in a small pottery vessel which contains water to moisten the thread for better spinning: a method used in pre-Columbian times throughout middle North America, Central America, and South America to Peru.

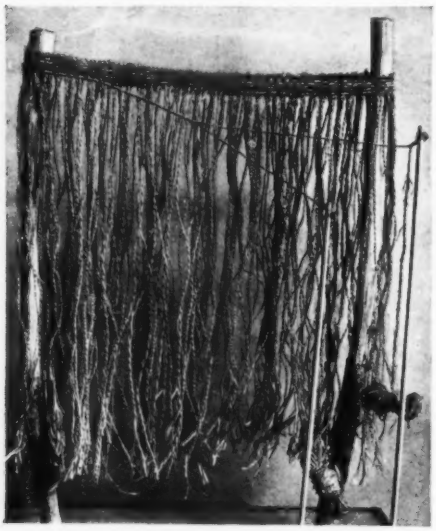
In the picture below, the mother is shown beating her daughter for unsatisfactory work

since the warps are attached only at the top; but in this case they do not hang from a bar but from a string stretched between two upright posts.

In ancient times other fabrics besides bags were made on this type of loom. In the narrative of Hernando de Soto, the Knight of Elvas describes the weaving of tapestry shawls containing white, gray, vermilion and yellow figures, on such a loom. The fibers used were occasionally of buffalo hair, but the commonest were bast fibers such as silk grass, Indian hemp, and the shredded bark of mulberry and cedar trees.

Aztec mother teaching her daughter to weave.— This shows the type of loom used in the New World cotton area. (Compare page 384). The girl is beating up a pick of weft with a "weave sword" held at right angles to the weft although it was once thought always to have been put in sideways. The partially woven fabric at top of loom shows how the warp threads were separated into equal groups and the weaving begun from the bottom up, as in certain unfinished Peruvian cloths found

It is singular to note that in the type of loom in which the warp threads are attached at one end only to a bar or string and at the other end are free, the principal fiber is bast. The nature of this fiber causes the thread to be much stiffer and less likely to tangle than cotton. Wool is purposely left out of this generalization, since, while occasionally employed as warp, its most general use is as weft. It is upon the character of the warp that the development and type of loom apparently depend.



The Ojibway bag loom, the most primitive type of loom, consists of two sticks with a string stretched between them. The warp threads depending from the string are free below, and the weft is threaded through with the slender rods at the side. This loom, used in ancient times for other fabrics besides bags, is the same type as the Greek, Scandinavian, and probably early Egyptian looms

It must be remembered that a loom is merely a convenience in weaving. The act of interlacing two sets of filaments at right angles can be performed without any tools. Take for example the fabrics of the northern Indians, made from strips of rabbit fur. Here no frame of any description is employed. One set, which we may term the warp, is merely stretched on the ground, and the second set, the weft, is laced each strip in turn over and under until the web is completed.

It is usual to refer to the type of loom

about to be described as "primitive," and compared with the wonderful machines of today, this is no doubt a correct description. Yet, in sober fact, the two-barred loom of our great cotton area, is actually a highly developed machine. It must have come at the end of long ethnological periods, and it remains in actual commercial use to this very moment for certain classes of fabrics such as rugs and tapestries. Besides all this, it contains every principle incorporated in the latest product of our great loom factories. There is no fabric made today which has not been made on this apparently simple framework of sticks and string; there are at least two interesting fabrics, true tapestry, and oriental pile-knot rugs, which are still made on it, and which cannot be made on any other type of loom.

Upper portion of Peruvian belt loom, showing loom bar (instead of string in Ojibway loom) to which the warp threads are directly attached. This arrangement, allowing no play or elasticity in the warps, is necessary for a close-textured fabric, in which firm beating up of the weft is necessary and where the weft alone is the decorative element. Below, the warps are shown divided into groups to avoid tangles in weaving

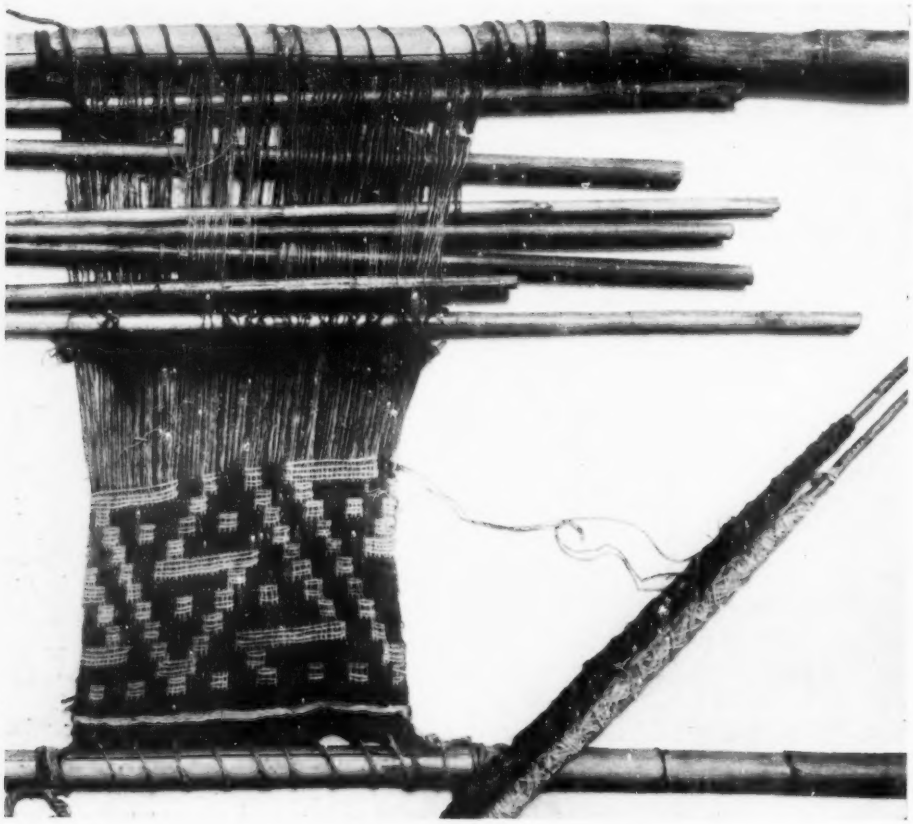
It is a grave error to imagine that the loom of today and its humble prototype are entirely disconnected phenomena. There is a perfect sequence of development from the one to the other, and no one can thoroughly comprehend a modern weaving machine who is not familiar with the earlier forms.

The particular invention which was the dividing line between modern looms and true hand looms, was of Chinese origin. The discovery of silk filament suggested the need of some way in which the great number of fine warp ends could be more easily manipulated than by the heald rods operated by hand. It was then discovered that by making the heald loops in a frame, or what we call a heddle, and attaching them by strings to a branch of a tree or some other support at the top, and by loops of cord to the feet of the weaver at the bottom, the warps could be more easily separated, and both hands left free for insertion of weft and for other important functions in weaving.

This particular type of loom is still used in India and gives no doubt a very fair idea of what the first Chinese treadle loom looked like. In the New World this form of loom occurs only with Spanish intrusion.

The great advance resulting from the use of heddles instead of healds to form sheds was purely of a mechanical nature. Its earliest simplest form, as well as the latest most technical refinement, were directed toward quantity instead of quality, increased yardage, instead of enhanced artistry. I am well aware that many exquisite fabrics were made on the earlier foot-treadle looms. The brocades of India, and of sixteenth and seventeenth-century European manufacture have well-deserved places in collections of art objects; but in artistic value they cannot compare with Oriental rugs and Flemish tapestries, nor indeed with the infinitely more ancient webs from the Peruvian desert.

That our textile art is the child of the more primitive loom no thoughtful person can doubt. It may come as a surprise however, to learn that every technical method of creating textile design originated from the same distant and simple source. But this is the fact. In the fabrics of old Peru — and no doubt the same could be said of ancient Mexico had the climatic conditions per-



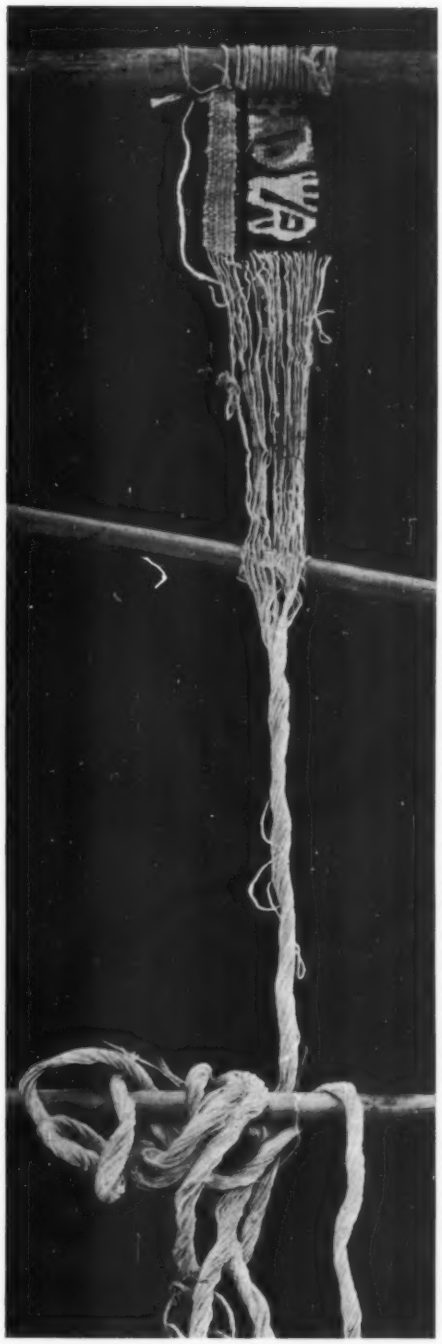
Peruvian loom showing partially finished web of double cloth; bobbins at right contain the weft yarn. Ancient type of loom common throughout southern North America, southward to Peru; similar to Asiatic rug loom. Warp threads are not attached directly to loom bar, but to a string attached to the bar by loops, thus giving the play to the warp necessary for fabrics in which both warp and weft enter equally into the decorative scheme. The middle bar with loops on it is a heald rod; the short sections of cane above were inserted to hold the warps in the sheds necessary to form the pattern. Every class of textile of which we know anything today was made on this loom in old Peru, and this type of loom is still used in India

mitted the record to be preserved—examples occur of the use of almost every device for fabric decoration which we know today.

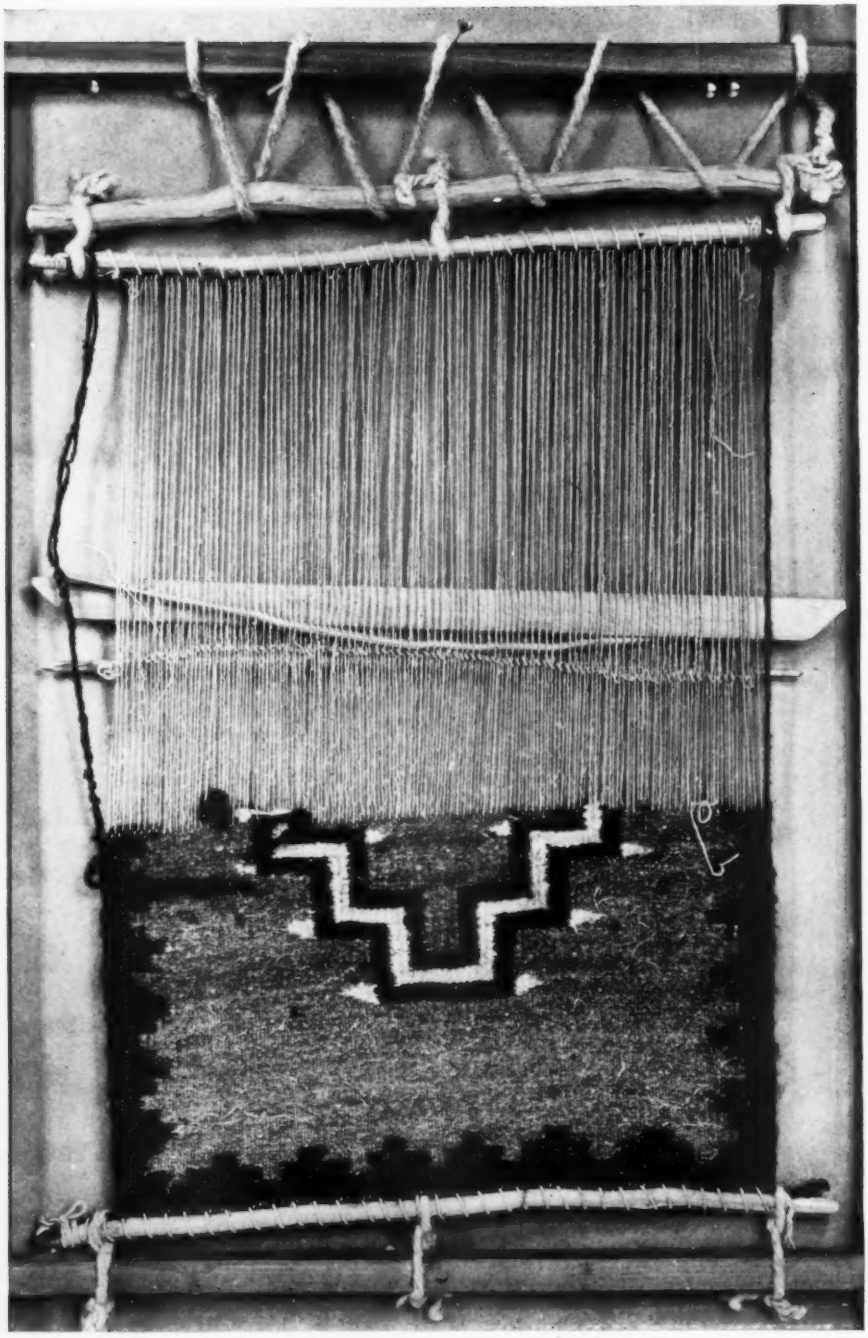
The proof of this rather sweeping statement will be offered in a paper soon to be issued. The subject is referred to at this time merely to sustain the contention that the study of the type of loom now to be considered has a deep interest even aside from archæology.

The simplest form of two-barred loom that I have ever seen, is illustrated in Dr. Roth's excellent paper entitled, "Some Technological Notes from the Pomeroon District, British Guiana." It is merely two sticks, parallel to each other and held apart by cords, on which a string is wound to form a simple warp. The warp threads are placed in the same plane preparatory to weaving, by twining two wefts at the lower part. There are no leash rods, such as occur in Navajo and other looms, to divide the warps into convenient form for weaving. Even the simplest form of heddle for opening the weaving sheds is absent, the paddle-shaped object being used for this purpose and also to beat the weft up after it is delivered.

It is quite proper for us to be amazed at the wonderful technical inventions of our race during the past few centuries. They have marvelously influenced the advancement of civilization and indeed form our chief basis of cultural superiority. We must remember however, that primitive peoples arrived at their mechanical results by the same hard road of ceaseless experiment and constant effort to overcome economic and technical obstacles. Each apparently simple device added to their looms from time to time was as truly an intellectual triumph as the more spectacular results of Arkwright or Crompton, of Jacquard or Northrup.



Peruvian belt loom similar to that shown on page 384; but showing also how short lengths of warp were stretched between bars for convenience in weaving. Below, the warps are twisted in a skein to avoid tangles

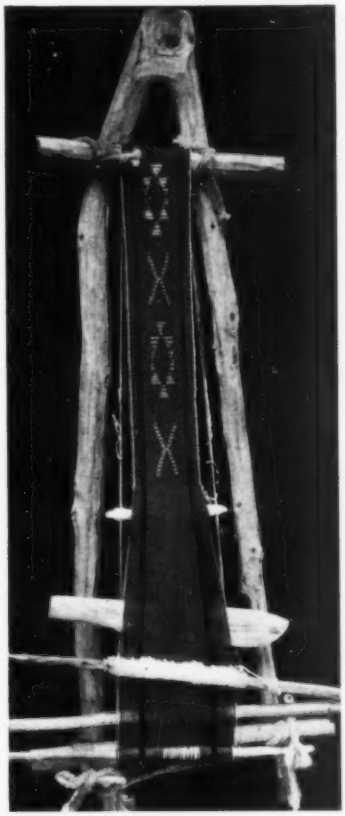


NAVAJO INDIAN LOOM

Although two thousand years of time separate this from the Peruvian loom (page 384), it is essentially of the same type. The warps are attached to a loom string. Of the three middle rods shown, the lower is the heald rod, the next the shed stick, and the upper the weave sword; the first two are used to separate the warps into sheds for weaving, the other to beat up the weft into the compact texture necessary for a tapestry fabric, in which the warps are entirely covered by the weft

The area of cotton culture in ancient times consisted of the southern portion of Utah, Mexico, and Central America, and almost the entire expanse of the Southern Continent, down to the central portion of the modern Republic of Peru. The two-barred loom had exactly the same distribution. The loom of the modern Hopi Indians is practically the same as that used by the pre-Incan peoples of Peru. The illustrations show this more clearly than could any discussion.

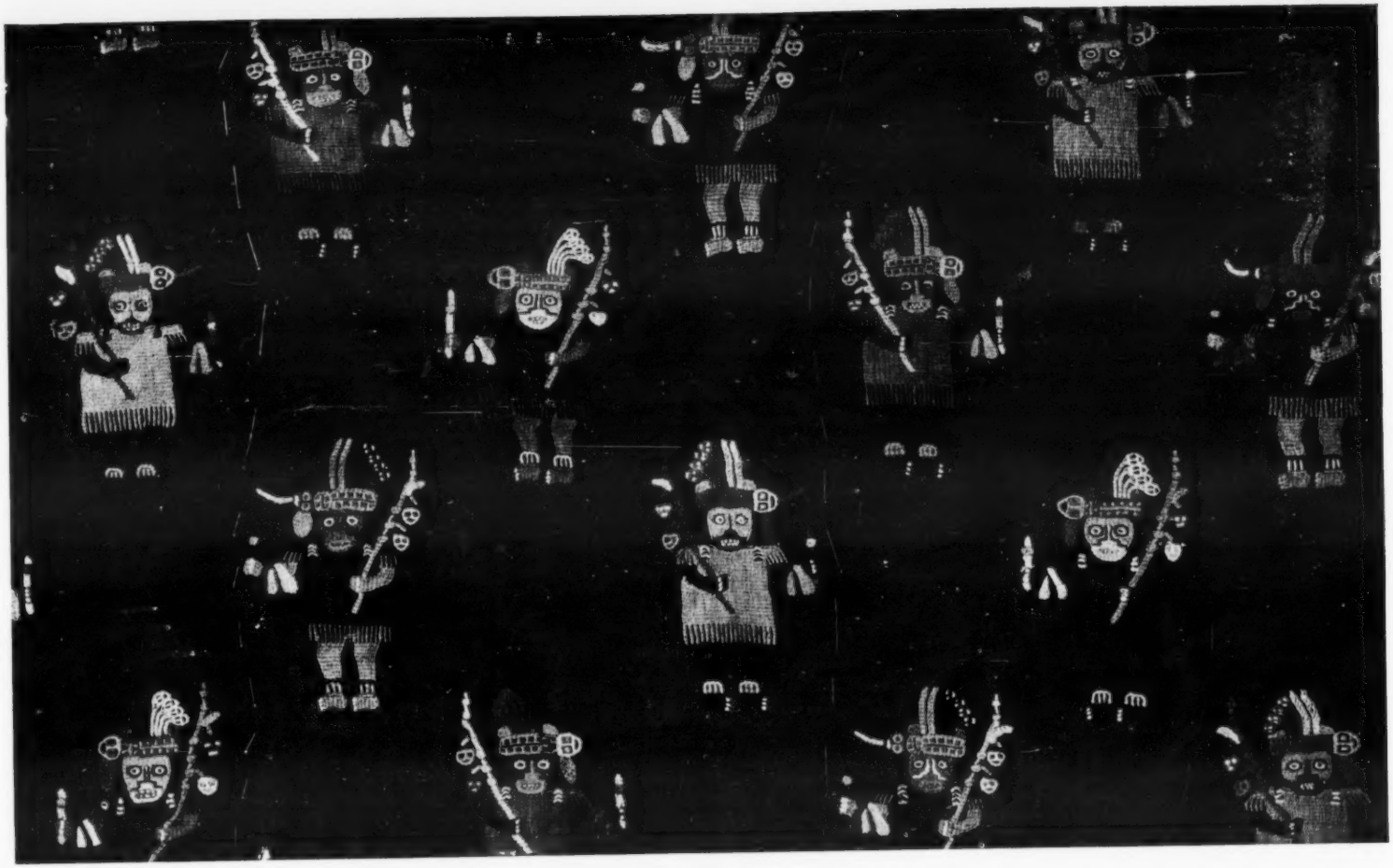
The impulse to discuss the wonderful products of these simple looms, in which the Museum collections are so rich, is almost irresistible. A famous silk designer spent a couple of hours recently in the Peruvian hall and said that there was inspiration sufficient for centuries of creation in this single hall, and had the recent fabrics of the Ica and Nasca collections, presented to the Museum by Mr. A. D. Juillard, been unearthed in Asia or Egypt they would have been the object of world-wide artistic and archæological interest.



Navajo belt loom.— Belts are one of the earliest forms of decorative textiles, and many of the most interesting designs have originated to adorn them

It is but fair to say that our textile designers are showing an increasing interest in these collections and that we may safely hope that a portion of their beauty will soon find expression on modern looms. We are returning to sit at the feet of the old masters of the New World.

Asia, up to now, has been the source of practically all our textile science and art. The contributions of Europe and America have been of a purely mechanical nature. The two-barred loom was indigenous in Asia as well as in the cotton area in the New World. The use of cotton in the Orient is so immensely ancient that no accurate date of origin can be given. The similarity in weaving is further borne out by a likeness in the method of spinning this fiber. It is therefore reasonable to assume that the technical peculiarities of cotton fiber are largely responsible for the form of the loom in both continents. However sound such a supposition may be, of one thing we can be certain: that the result is the highest tribute possible to the ingenuity of the human mind. The enterprise and mechanical genius of the past three centuries have added many labor-saving devices, such as the application of power and marvelous automatic features; but the principle, the basic philosophy, has remained unchanged since its development by the intellects of the forgotten centuries.



EMBROIDERY FROM ICA, PERU

The above represents part of a shawl-like garment from Peru, in almost perfect condition, which exhibits remarkable skill in embroidery. It consists of a plain, loosely woven woolen fabric, covered with a repetition of one figure in various and beautiful color combinations. The embroidery stitches are all of the same length and exceedingly even, in spite of the simplicity of the loom used. The warrior depicted carries over his shoulder two heads of his enemies

Ancient Peruvian Cloths

By C. W. MEAD

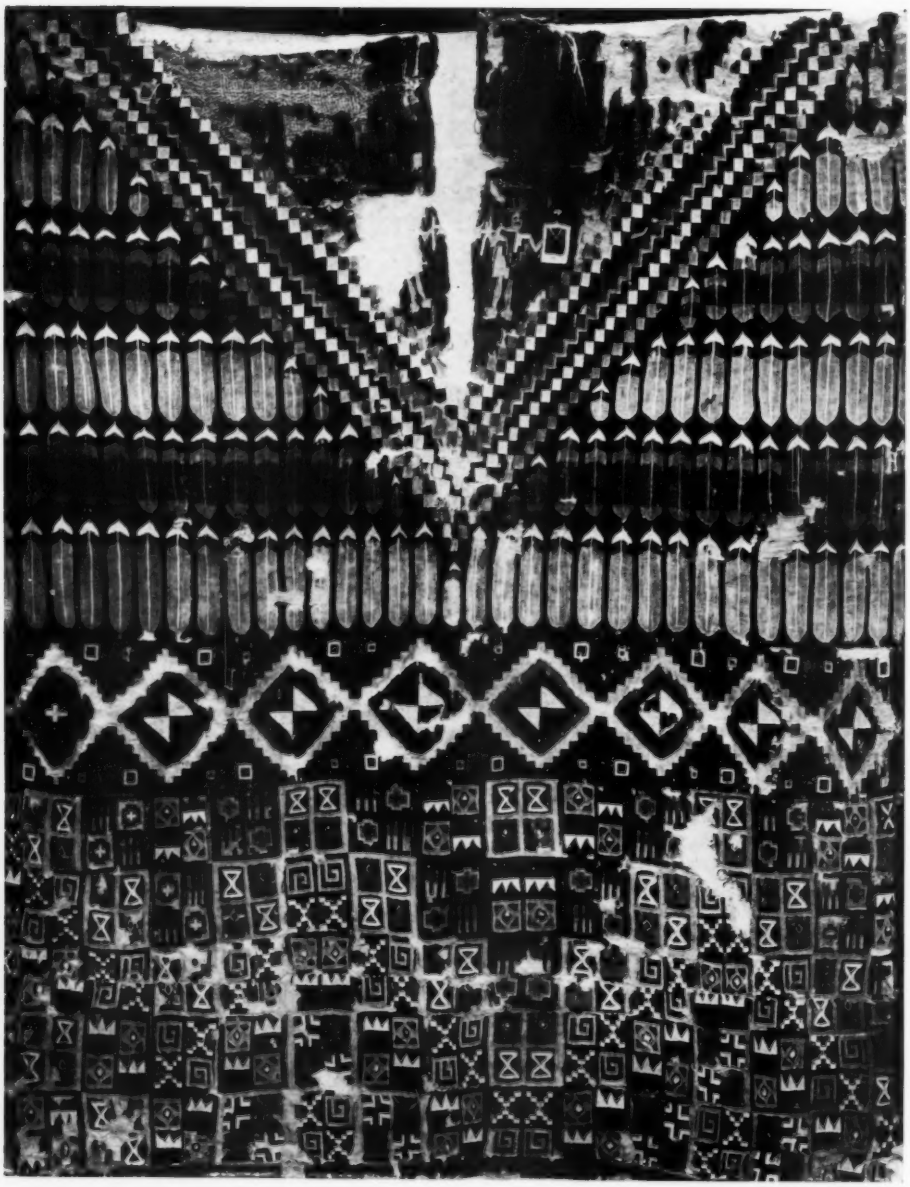
With illustrations from textiles in the American Museum

EXAMPLES of every style of weaving known at the present day can be found in the collection of prehistoric Peruvian textiles on exhibition in the South American gallery of the American Museum of Natural History. Here also may be seen looms from the ancient graves at Ancón and Pachacamac, with cloth in the process of manufacture. They are of very simple form; two sticks, one at the top and the other at the bottom, over which the warp threads are stretched. About these threads are the loops or "leashes" that lift them for the passage of the shuttle, taking the place of heddles in the modern heald, or harness. Several cross-rods were generally used to keep the threads of the warp in position, and a batten to drive home the thread of the woof. In modern looms the "reed," a fixed comb, drives in the woof threads by blow of the "lay." Small sticks, tapering to a point at both ends, answered for shuttles, and upon these the colored threads were wound.

For materials the ancient Peruvians had cotton of fair staple and of two colors — one snowy white, the other a beautiful golden brown. Their wool came from the fleeces of three members of the camel family, the llama, alpaca, and the vicuña. The first wool is coarse and was but seldom used; the qualities of alpaca wool are well known; vicuña is much finer than alpaca and very silk-like, and this was the material used in making the most beautiful specimens that have come down to us. The product is always spoken of as vicuña cloth, but the warp is of cotton.

In weaving such cloth it is essential that the warp threads should be very strong, and at the same time much smaller than those of the woof or filling. Cotton, being stronger than wool, was better material from which to make these fine, tightly-twisted threads. The vicuña yarns of the woof, being loosely-twisted and much larger, could be beaten

Part of large shawl-like garment of cotton cloth with a border of vicuña wool, from the Peruvian coast, near Lima. The animal figures represent the puma

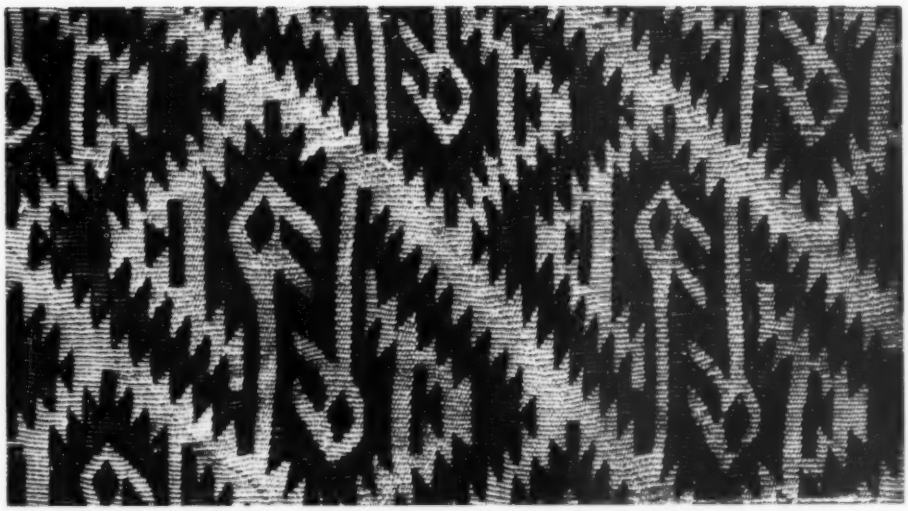


ANCIENT INCAN PONCHO

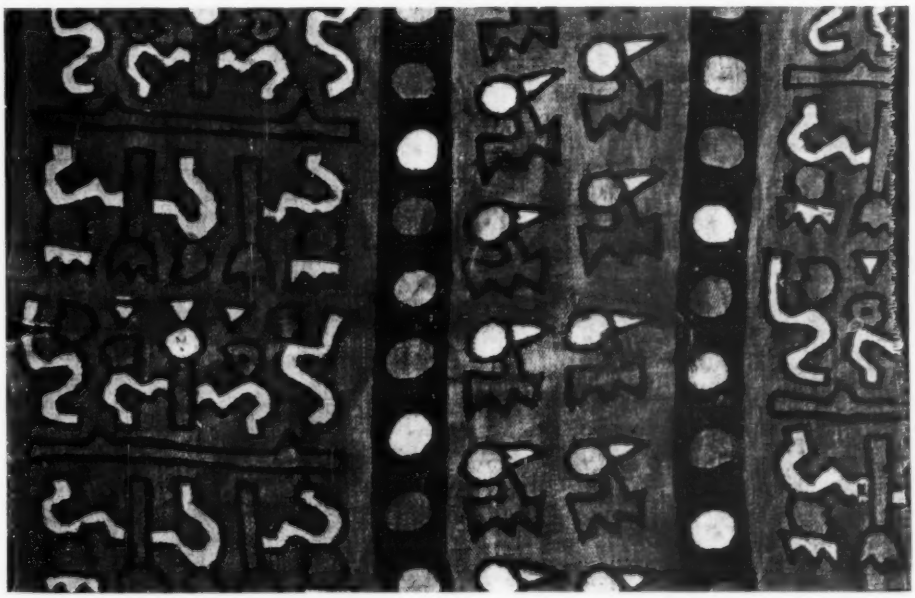
Near the opening for the head the Inca is shown, with his battle-axe and shield and wearing a poncho. The decorations in the upper half of the garment represent feathers; below they are geometrical designs. This poncho comes from the island of Titicaca, Bolivia

down with the baton or weaver's sword until they met over the cotton warp threads and completely covered them. For twisting their threads the Peruvians used wooden spindles weighted with whorls, which were generally made of clay, tastefully decorated.

In the fall of 1912 the Museum's exhibit of these old Peruvian textiles was installed in the South American gal-



Tapestry from Ancón, Peru. The warp is of cotton; the weft of vicuña wool. This design of birds' heads and geometrical designs in yellow on a deep reddish-brown ground, is strikingly decorative and has been extensively copied by artists



Cotton cloth from Casma, Peru. The design is painted in black on a plain white ground. These painted cloths appear to have been very common in Peru

lery. It shows many different weaves, the most beautiful pieces being in the form of tapestry.

It is doubtful if any other field of primitive art furnishes an equally good opportunity for the study of color schemes and conventionalized designs. That this has been recognized and appreciated is attested by the fact that these textiles are studied, and have been

INCAN PONCHO FROM THE ISLAND OF TITICACA, BOLIVIA

The two lower rows of squares show human figures and the puma. The squares above contain, for the most part, geometrical designs, but in some of them birds are represented flying up to or down from the clouds, the step-form figures probably representing clouds. Silver tinsel yarn in considerable quantity is woven into this poncho. This yarn was spun in Peru by twisting a thin band or ribbon of silver about a finished yarn of cotton

for some years, by an average of one hundred and fifty art students each month, who carry away with them for future use copies in black and white and in colors of these color schemes and designs.

Aside from their value to artists and art students, these old Peruvian textiles claim our admiration from a technical point of view. This side of the subject, although of very great interest, will not be taken up here, as it has been treated in a paper by Mr. M. D. C. Crawford, published by the Museum in its anthropological series. Mr. Crawford is interested in the textile business, and is familiar with the history of textiles, and with the materials and machinery used in the processes of spinning and weaving. The wonderfully complex machines of the present day but repeat the processes formerly performed by the weaver's fingers. The finest textiles known have been made by hand; machines have not made fabrics more perfect. Mr. Crawford's paper will be the first to treat the prehistoric Peruvian cloths from a purely technical point of view.

We do not know the age of the Peruvian fabrics. They probably belong to different epochs, and while a part of them may not greatly antedate the historical period (1532), others are undoubtedly of a very much greater age, perhaps several thousand years older. This assumption is reasonable and in accordance with what we know of the development of other arts and industries.

All things connected with old Peru are associated in the popular mind with the Inca.

Now the truth of the matter is that the coast region did not come under the Inca sway until about one hundred to one hundred and fifty years before the conquest, and most of these fabrics were made many centuries before that time. Various localities included within the boundaries of ancient Peru, have furnished us with specimens of this cloth; but by far the greater number of specimens comes from the coast region, which is largely a desert of dry, nitrous sand, well adapted to their preservation. So well are the fabrics preserved that many of the pieces are as strong, and their colors apparently as bright, as when taken from the primitive loom. The ancient inhabitants lived in the fertile valleys of the rivers flowing from the Cordillera to the Pacific, and buried their dead in the desert sand near, and it is from these graves that the best-preserved specimens come. It was a very long step indeed from the first attempts at weaving to the production of these beautiful fabrics.

The designs, and something of the textures, of the Museum's mummy cloths are shown in the illustrations, but the wonderful color schemes, which never fail to delight the artist's eye, are all but lost, as they always must be when photography is relied upon for their reproduction.

TERNS, CORMORANTS, AND PELICANS ON KLAMATH LAKE, OREGON

This huge lake with its stretches of tule islands, was made a bird reservation eight years ago and is now the home of great colonies of pelicans, gulls, cormorants, and terns, with ducks, geese, and many other birds. The great blue herons build their platform nests over an area of several acres; the pelicans, once near extermination in this region owing to the quill hunters, now sit in rows, hundreds together, and view with calmness the close approach of the Audubon patrol boat. Western grebes were once so nearly exterminated that they are not numerous even yet, after eight years of protection

A village of Farallon cormorants on lower Klamath Lake, receiving a visit from the writer

Uncle Sam's Birds

By T. GILBERT PEARSON

Secretary, National Association of Audubon Societies

The JOURNAL publishes as a third article in the series from Mr. Pearson's book soon to be brought out by Doubleday, Page and Company, this chapter on bird reservations. It is with unusual satisfaction that we read the vividly told story of the growth of federal protection, together with descriptions of various rookeries, such as that in the "Big Cypress" near Fort Myers, Florida, and accounts of the splendid loyalty of the wardens who daily hold watch over the birds.

There should be added to this story of bird protection, the legislative triumph which has just come to pass, through the final ratification by Congress on August 29 of an international treaty for conservation of all migratory birds of the North American continent. This treaty, now active law in Canada and the United States north of Mexico, was initiated more than two years ago by Senator George P. McLean of Connecticut. It followed through the necessary course in Canada, then came down from Ottawa in the August just past, to meet success or failure in Washington. Great was the delight of those interested either from the economic side or from sentiment, to see the treaty pass quickly through the hands of the Secretary of State, the British Ambassador, the President, and go to the Senate, where it was made law by a two-thirds majority vote. It is prophesied that the enactment of this international law protecting migratory birds will prove the most far-reaching of any step ever taken in any country for the increase of the native bird life. [*See page 410 for some of the specific restrictions of the treaty.*]—THE EDITOR.

THE creation of reservations where all wild birds may be protected at all times is a very modern idea and was first brought prominently to public attention by the efforts of the Audubon Society. The United States Government first manifested an interest in this subject about thirteen years ago, and it came about in this manner. On May 29, 1901, the legislature of Florida was induced to enact a statute making it a misdemeanor to kill any of the non-game birds of the state, with the exception of the crow and a few other species regarded by the lawmakers as being injurious to man's interests in some way.

Shortly afterward, the Audubon Society employed a man to protect from the raids of tourists and feather-hunters a large colony of brown pelicans that used as a nesting site a small, muddy, mangrove-covered island in Indian River on the Atlantic coast of the state. Soon murmurings began to be heard. "Peli-

cans eat fish and should not be protected," declared one Floridian. "We need Pelican quills to sell to the feather-dealers," chimed in another with a keen eye to the main chance. There was talk of repealing the law at the next session of the legislature, and the hearts of the Audubon workers were troubled. At first they thought of buying the island, and putting themselves thus in a position to protect its feathered inhabitants by preventing trespass. The island proved however, to be unsurveyed government land, and some one suggested the idea of getting the government to make it a reservation to protect the birds. At length the matter was submitted to President Roosevelt, who no sooner ascertained that the land was not suited for agricultural purposes, and that the Audubon Society would guard it, than, with characteristic directness, he issued the following remarkable edict: "It is hereby ordered that Pelican Island in Indian River is reserved and set apart for the use of the Department of Agriculture as a preserve and breeding ground for native birds."

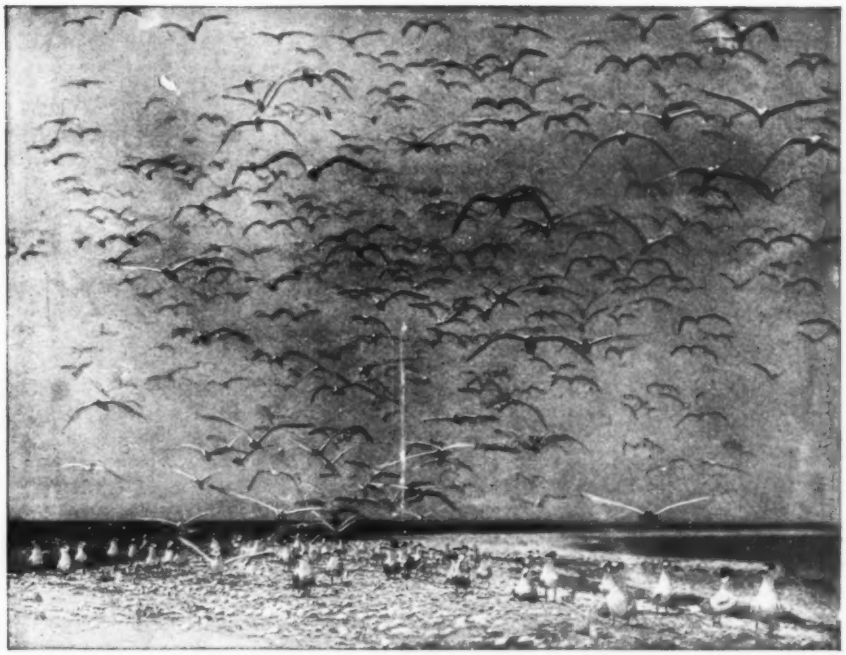
The gist of this order, bearing the authorization of the Secretary of Agriculture, was shortly painted on a large sign, which was then placed on the island, where all who sailed near might read. Imagine the chagrin of the Audubon workers upon learning from their warden that, when the pelicans returned that season to occupy the island as before, they took one look at this declaration of the President and immediately departed, one and all, to a neighboring island entirely outside of the reservation! Signs less alarming in size were substituted, and the pelicans, their feelings appeased, graciously returned, and to the joy of all concerned have since dwelt there peacefully, and flourished under the protecting care of the government.

In view of the fact that some people contended that the President had overstepped his authority in making a bird reservation, a law was drafted, and passed by Congress specifically giving protection to birds on lands set apart as national bird reservations. The legal difficulties now removed, the way lay open for the creation of other bird reservations, and the Audubon Society eagerly seized the opportunity. Explorations were at once begun to locate such other government territories as might be found to contain important colonies of water birds, and this work was quickly extended over many parts of the United States. Plumage hunters and eggers were busy plying their trade wherever this class of birds was known to collect in numbers, and the work had to be hurried if the birds were to be saved.

Mr. Frank M. Miller, of New Orleans, reported a case in which five thousand eggs were broken on one Louisiana island inhabited by sea birds, in order that fresh eggs might subsequently be gathered by the eggers whose waiting boats lay at anchor offshore. No wonder the friends of the birds were profoundly disturbed concerning the future welfare of the wild water birds, and hailed with delight the accession to their ranks of the daring, quick-acting Mr. Roosevelt.

So enthusiastic was Mr. William Dutcher, president of the National Association of Audubon Societies, with the results achieved in federal reservation work in 1905, that he declared in his annual report that if the Association had done nothing else than secure federal bird reservations and help guard them during the breeding season, its existence would be fully warranted.

President Roosevelt established that year four more bird refuges; one of these, Stump Lake, in North Dakota,



Royal terns on an island off the North Carolina coast, owned by the North Carolina Audubon Society. The breeding places of the sea birds are cared for by the Society with the result that ten thousand young birds were reared one summer recently on the rookery islands

The demand for the skins of terns and gulls for the millinery trade and the resulting wholesale slaughter, have made these birds extremely scarce in many regions. On the bird reservations, storms and high tides are now their only enemies, but these causes sometimes destroy many thousands of eggs a year

was an important nursery of gulls, terns, ducks, and cormorants in summer, and a safe harbor for wild fowl during the spring and fall migrations. Huron and Siskiwit islands, lying in Lake Superior, and the homes of innumerable herring gulls, were made perpetual bird sanctuaries, and an Audubon warden took up his lonely watch to guard them against all comers.

Noddy terns, on the Bird Key reservation, Dry Tortugas, Florida. The noddies build their nests of twigs, moss, and sea shells in the bay cedar bushes

Away down at the mouth of Tampa Bay, Florida, is the ninety-acre island of Passage Key. Here the wild bird life of the Gulf Coast has swarmed in the mating season since the white man first knew the country. Thousands of herons of various species, as well as terns and shore birds, make this their home. The dainty little ground doves flutter in and out among the cactus on the sheltered sides of the sand dunes; plovers and sandpipers chase one another along the beaches, and the burrowing owls hide in their holes by night and explore the island by day.

When this place was described to President Roosevelt, he immediately declared that birds must not be killed here any longer without the consent of the Secretary of Agriculture. With one stroke of his pen, he brought this desired condition into existence, and Mrs. Asa Pillsbury was duly appointed to protect the island. She is one of the few women bird wardens in America.

These things happened in the early days of government work for the protection of water birds. The Audubon Society had found a new field for endeavor, which was highly prolific in results. With all the limited means at its command, the work of ornithological exploration was carried forward. Every island, mud flat, and sand bar along the coast of the Mexican Gulf, from Texas to Key West, was visited by trained ornithologists, who reported their findings to the New York office. From here they were hurried to Washington for the approval of Dr. T. S. Palmer of the U. S. Biological Survey, and of Mr. Frank Bond, of the General Land Office, where the executive orders were prepared for the President's signature.

The Breton Island reservation off the coast of Louisiana, including scores of islands and bars, was established in 1904. Six additional reservations were soon afterward created along the west coast of Florida, thus extending a perpetual guardianship over the colonies of sea and coastwise birds in that territory, — the pitiful remnants of the vast rookeries which had been despoiled to add to the profits of the millinery trade.

The work was early started in the

West, where Malheur Lake and Klamath Lake reservations, in Oregon, resulted. The latter is today the summer home of myriads of ducks, geese, grebes, white pelicans and other wild waterfowl, and never a week passes but that the waters of the lake are fretted with the prow of the Audubon patrol boat, as the watchful warden extends his vigil over these feathered wards of the Government.

Not only have lakes with reedy margins, and lonely islands in the sea, been turned into federal bird reservations, but such reservations have been made to include also numbers of the big government reservoirs built in the arid regions of the West.

Once set in motion, this movement for federal bird reservations soon swept beyond the boundaries of the United States. One was established in Porto Rico, and several others among the Aleutian Islands of Alaska, where on the rocky cliffs may be seen today clouds of puffins, auks and guillemots (queer creatures which stand upright like a man), shouldering and crowding one another about on the ledges overlooking the dark waters of Bering Sea. One reservation in Alaska covers much of the lower delta of the Yukon, including the great tundra country south of the river, and embracing within its borders a territory greater than the state of Connecticut. From the standpoint of preserving rare species of birds, this reservation is doubtless one of the most important which has thus far come into existence. It is here that many of the wild fowl which frequent the California coast in winter, find a summer refuge safe alike from the bullet of the white man and the arrow of the Indian. Here it is that the lordly emperor goose is making probably its last stand on the American continent against the aggressions of the destructive white race.

Away out in the western group of the Hawaiian Archipelago are located some of the world's most famous colonies of birds. From over vast regions of the Pacific, the sea birds journey hither when the instinct for mating comes strong upon them. Here come the "love birds" or white terns, and many albatrosses, those great winged wonders whose home is on the rolling deep. Their numbers on these islands are such as to be almost beyond the belief of men who are unfamiliar with bird life in congested colonies. On February 3, 1909, these islands and reefs were included in an executive order whereby the Hawaiian Island reservation was brought into existence. This is the largest of all our government bird reserves, and extends through more than five degrees of longitude.

At intervals in the past these islands had been visited by vessels engaged in the feather trade, and although no funds were available for establishing a warden patrol among them, it was fondly hoped that the notice given to the world that the birds here were now the wards of the United States would be sufficient to insure their safety.

A rude shock was felt, therefore, when late that year a rumor reached Washington that a Japanese poaching vessel had been sighted heading for these waters. The revenue cutter "Thetis," then lying at Honolulu, was at once ordered on a cruise to the bird islands. Early in 1910, the vessel returned, bringing with her twenty-three Japanese feather hunters who had been captured at their work of destruction. In the hold of the vessel were stored two hundred and fifty-nine thousand pairs of wings, two and a half tons of baled feathers, and several large cases and boxes of stuffed birds, for which, had the Japanese escaped with their booty, they would have realized

over one hundred thousand dollars. This island was again raided by feather collectors in the spring of 1915.

President Taft continued the policy of creating bird reservations begun by Mr. Roosevelt, and a number were established during his administration. President Wilson likewise is a warm friend of bird protection and has given these measures his support. One of many reservations he has created is the Panama Canal Zone which, however, is in charge of the Panama Canal Commission. With this exception, and that of the Pribilof reservation, which is in charge of the Bureau of Fisheries, all government bird reservations are under the care of the Department of Agriculture and their administration is directly in charge of the Bureau of Biological Survey. The National Association of Audubon Societies still contributes in a modest way to the financial support of some of the wardens.

It may be noted that there are no government bird reservations in the original thirteen colonies. This is because there were no government waste lands containing bird colonies in these states. To protect such colony-breeding birds as were here found, therefore, other means were necessary. The subject is well taken care of by the Audubon Society, which from its New York office employs annually about fifty agents to guard in summer the more important groups of water birds along the Atlantic Coast, and about some of the lakes of the interior. Water bird colonies are usually situated on islands where the birds are comparatively free from the attacks of natural enemies, hence the question of guarding them resolves itself mainly into the question of keeping people from disturbing the birds during the late spring and summer months. Painted signs will not do this. Men hired for the purpose constitute the only safe means. Some of the protected islands have been bought or leased by the Audubon Society, but in many cases they are still under private ownership and the consent necessary for placing a guard there has been obtained as a favor from the owner. Probably half a million breeding water birds now find protection in the Audubon reservations. On the islands off the Maine coast the birds chiefly safeguarded by this means are the herring gull, Arctic tern, Wilson's tern, Leach's petrel, black guillemot, and puffin. There are protected colonies of terns on Long Island, terns and laughing gulls on the New Jersey coast, and colonies of black skimmers, and various terns in Virginia and North Carolina.

One of the greatest struggles which the Audubon Society has ever had has been to raise funds to protect the colonies of egrets and ibis in South Atlantic states. The story of this fight is longer than can be told here. Briefly, — the protected colonies are located mainly in the low swampy regions of North Carolina, South Carolina, Georgia and Florida. I have been in many of these "rookeries" and know that the warden who undertakes to guard one of them takes his life in his hand. Perhaps a description of one will answer more or less for all the twenty others the Society has under its care.

Some time ago I visited the warden of the Corkscrew Rookery, located at the edge of the "Big Cypress" swamp, thirty-two miles south of Fort Myers, Florida. Arriving at the colony late in the evening, after traveling thirty miles without seeing a human being or a human habitation, we killed a rattlesnake and proceeded to make camp. The shoutings of a pair of sand-hill cranes awakened us at daylight, and, according to Greene, the warden, the sun was about

"two hands high" when we started into the rookery. We crossed a saw-grass glade two hundred yards wide and then entered the swamp. Progress was slow, for the footing was uncertain and the tall saw grass cut our wrists and faces upon the slightest provocation.

There are many things unspeakably stimulating about a journey in a tropical swamp like this. You work your way through thick, tangled growths of water plants and hanging vines. You clamber over huge fallen logs damp with rank vegetation, and wade through a maze of cypress "knees." Unwittingly, you are sure to gather on your clothing a colony of ravenous ticks from some swaying branch. Red bugs bent on mischief scramble on you by the score and bury themselves in the skin, while a cloud of mosquitoes waves behind you like a veil. In the somber shadows, through which you move, you have a feeling that there are many unseen things that crawl and glide and fly, and a creepy feeling about the edges of your scalp becomes a familiar sensation. Once we came upon the trail of a bear and found the going easier by wading on hands and knees through the opening its body had made.

In the more open places the water was completely covered with floating water plants, which Greene called "wild lettuce." These appeared to be uniform in size, and presented an absolutely level surface except in a few places, where slight elevations indicated the presence of inquisitive alligators, whose gray eyes we knew were watching our movements through the lettuce leaves.

Although the swamp abounded in unpleasant conditions under foot, we had but to raise our eyes to behold a world of beauty. The purple blossoms of air plants, and the delicate petals of other orchids greeted us on every hand. From the boughs overhead, long banners of gray Spanish "moss" waved and beckoned in the breeze. Still higher, on the gaunt branches of the giant cypresses a hundred feet above, were the great wood ibises standing on their nests, or taking flight for their feeding grounds a dozen miles to the southward.

We were now fairly in the midst of an immense bird city, and some of the inhabitants were veritable giants in the bird world. The body of a wood ibis is about the size of a turkey hen. Its long neck terminates in a most remarkable appendage, for the top of the head is not only innocent of feathers but is also destitute of skin — "flintheads" the people call them. The bill is nearly ten inches long, is slightly curved and very massive. Woe to the unlucky fish and alas for the luckless rat when once the blow falls from the flinthead's heavy beak! There were probably one hundred thousand of these birds inhabiting Corkscrew Rookery at the time of my visit. Then, too, there were large colonies of the smaller white ibis and several varieties of herons. Once, eight of the almost extinct roseate spoonbills wheeled into view above the swamp, but quickly passed from sight.

The most interesting birds here, and those concerning which the Audubon Society is most solicitous, are the white egrets. These snowy birds, of exquisite beauty and queenly grace, have been persecuted for their plumes in this country almost to the point of extermination, and here is situated the largest assemblage of them left in Florida.

"These 'long whites' are never off my mind a minute," said the warden, as we paused to watch some fly over. "Two men came to my camp last week who thought I didn't know them, but I did. They were old-time plume hunters. They said they were hunting cattle, but

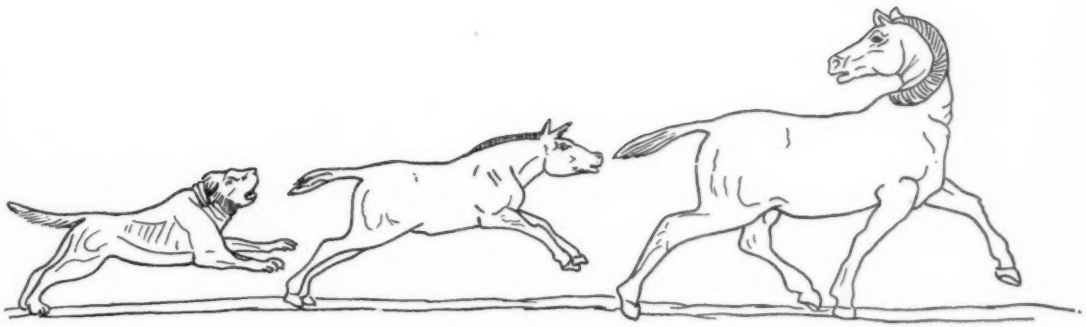
I knew better — they were after egrets and came to see if I was on watch. I told them if they saw anyone after plumes to pass the word that I would shoot on sight any man with a gun who attempted to enter the Corkscrew, and I would do it too," he added, as he tapped the barrel of his Winchester. "It is terrible to hear the young birds calling for food after the old ones have been killed to get the feathers for rich women to wear, and I am not going to have my birds sacrificed that way."

This is a region where the Audubon warden must constantly keep his lonely watch, for should he leave even for a short time there would be danger of the colony being raided and all the protective work of many seasons wiped out. A successful shooting trip of plume hunters to the Corkscrew might well net the gunners as much as five thousand dollars, and this, in a country where money is scarce, would mean a magnificent fortune. The warden is fully alive to this fact, and is ever on the alert. Many of the plume hunters are desperate men, and he never knows what moment he may need to grasp his rifle and defend his life, away down there in the shadows of the Big Cypress, where the alligators and vultures would make short shrift of his remains.

He remembers, as he goes his rounds among the birds day by day, or lies in his tent at night, that a little way to the south on a lonely sand key, lies buried Guy Bradley, who was done to death by plume hunters while guarding for the Audubon Society the Cuthbert egret rookery, and that even at this time, above him on Orange Lake, the warden in charge carries in his body the bullet from a plume gatherer's gun. Only three days before my visit, Greene's nearest brother warden, on duty at the Alligator Bay colony, had a desperate rifle battle with four poachers who, in defiance of law and decency, attempted to shoot the egrets which he was there to guard.

I like to think of Greene as I saw him the last night in camp, his brown lean face aglow with interest as he told me many things about the birds he guarded. The next day I would leave him, and night after night he would sit by his fire, a lonely representative of the Audubon Society away down there on the edge of the Big Cypress, standing as best he could between the lives of the birds he loved and the insatiable greed of fashion.

Army of young white pelicans at Klamath Lake reservation, Oregon



Ancient Tibetan hunting dog pursuing wild horses. [After Kraemer]

Hunting Dogs of the Ancients

By CHARLES R. EASTMAN

"WHEN Alexander the Great was on his Indian expedition, he was presented by the King of Albania with a dog of unusual size; being greatly delighted with its noble appearance, he ordered bears, and after them wild boars, and then deer, to be let loose before it; but the dog lay down and regarded them with a kind of immovable contempt. The noble spirit of the general became irritated by the sluggishness thus manifested by an animal of such vast bulk, and he ordered it to be killed. The report of this reached the king, who accordingly sent another dog, and at the same time sent word that its powers were to be tried, not upon small animals but upon a lion or elephant; adding that he had had originally but two, and that if this one were put to death, the race would be extinct."

"Alexander, without delay, procured a lion, which in his presence was immediately torn to pieces. He then ordered an elephant to be brought, and never was he more delighted with any spectacle; for the dog, bristling up its hair all over the body, began by thundering forth a loud barking, and then attacked the animal, leaping at it first on one side and then on the other, attacking it in the most skilful manner, and then again retreating at the opportune moment, until at last the elephant, being rendered quite giddy by turning round and round, fell to the earth, and made it quite resound with its fall."

In the narrative just related, which is found in the eighth book of Pliny's *Natural History*, written in the first century of our era, we find mention of a fierce race of hunting dog bred by the Albanians. Questions of no little scientific and historical interest arise, namely, whence came this powerful variety of dog of the East? And how was it related to other canine breeds that were used in ancient times in the chase of great animals, or to the greyhound, used in coursing for hares?

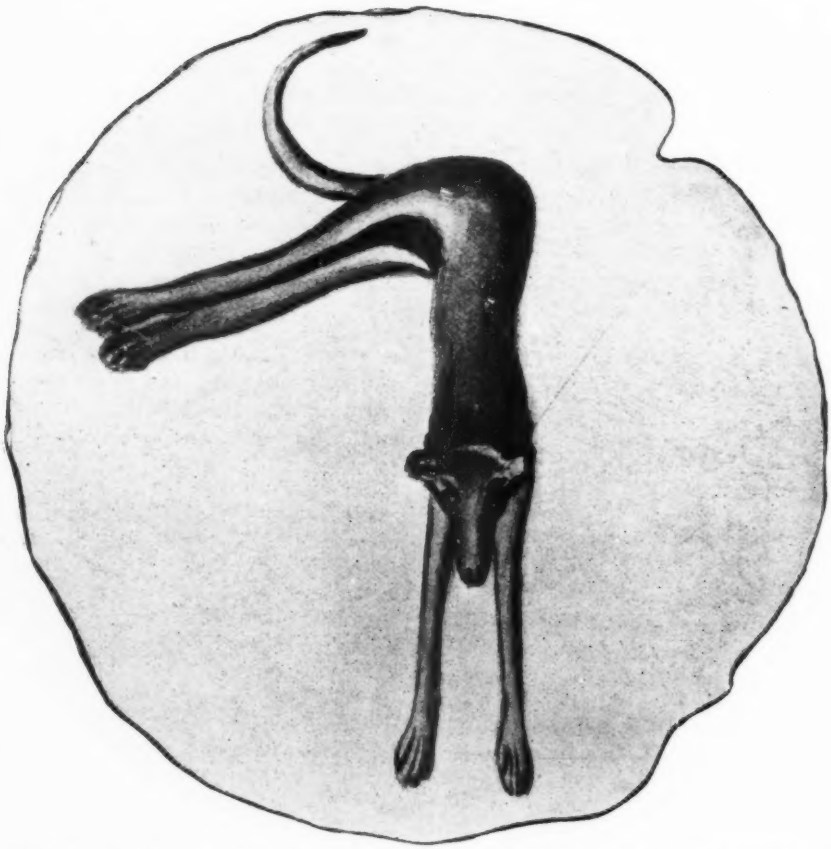
For an answer to these questions we must interrogate those monuments which have come down to us from remote antiquity, and represent for us the very earliest glimmerings of light that appear — after the long night of prehistoric darkness — in Babylonia, Assyria and Egypt. Here we find an interesting tale unfolded.

Directing our attention as far backward as the earliest culture strata in Turkestan, which correspond to the metal periods in Europe, we find several varieties of Canidæ abundantly represented, among them the so-called "dog of Anau," brought to light in the excavations of the citadel of that name. This was a domesticated canine of moderate size, standing with respect to its cranial structure very near to the primitive dingo, and also to a small wild dog of the palæolithic period (*C. poutiatini* Studer), which latter is regarded as the probable ancestor of the shepherd dog.

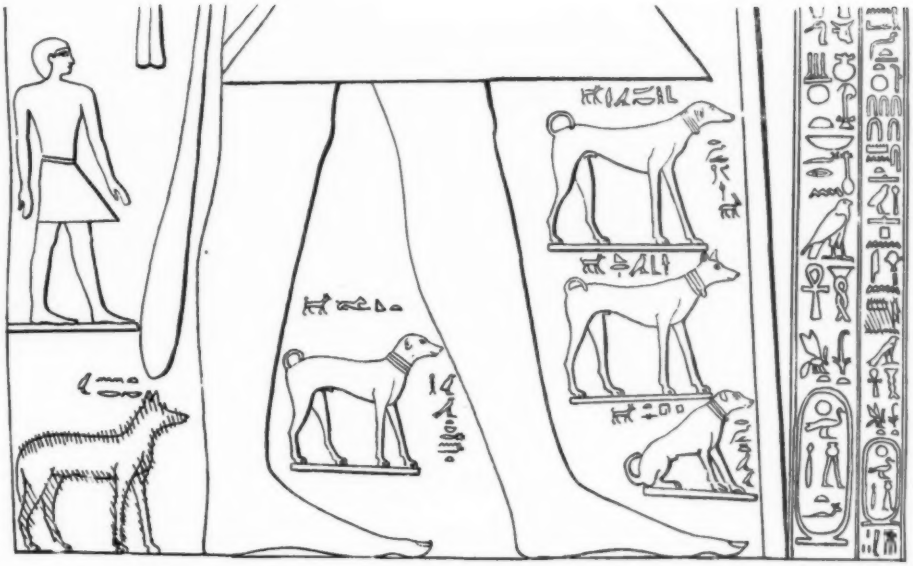
In vain do we search the Assyro-Babylonian monuments for indications of the shepherd dog of the East; in them are represented only the huge Tibetan mastiff and

Courtesy of Boston Museum of Fine Arts

Hunting scene from a Rhodo-Milesian vase of the seventh century, B.C.



Cretan, erect-eared hound, dating from earliest Minoan times, about 4000 B.C. (From cover of a steatite vessel found at Mochlos). The Cretan hound is abundant in Crete today and has an extremely ancient lineage, which can be traced back to a prehistoric domestication of the Abyssinian wolf. [From *Nouveaux Mem. Soc. Helv. Sci. Nat.* Vol. XLVI]



Courtesy Metropolitan Museum of Art, N. Y.

Egyptian hunting dogs represented on a royal monument found at Thebes, dating from the eleventh dynasty, about 2100 B.C. The stela shows King Horus accompanied by one attendant and five of his dogs. The dogs are of a southern race for they have Berber names inscribed in hieroglyphs above their figures. In three cases a translation of the foreign name into Egyptian is written vertically before the dog's breast

greyhound. From this may be inferred that the ancient Assyrians had no relation with the later inhabitants of Anau, and that their large hunting dogs with drooping ears, not distantly related to the modern St. Bernard, were of different origin from those which we find in central Asia and in Egypt. On the other hand, the interesting fact that the Anau type of dog is found in ancient Egypt tends to confirm the current opinion that the primitive inhabitants of the Nile valley migrated from central Asia into northwest Africa by way of the Red Sea, and brought with them this dog as well as the long-horned cattle, which are undoubtedly of Asiatic origin.

There are found in ancient Egyptian monuments, and also among mummified remains, numerous indications of an erect-eared, short-muzzled, smooth-haired dog, which, in the opinion of experts, "seems to correspond well with the Anau dog," a subspecies which has received the distinctive name of *Canis familiaris matris optimæ*.[1] Through commercial intercourse this type was carried from Egypt into ancient Greece, and from the Balkan region it spread into Austria and central Europe during the early historical period. The so-called *Canis molossus* of the ancients, and also the modern St. Bernard, seem to have been derived from that domestication in western Asia to which the powerful mastiff-like Assyrian hunting dogs belonged, such as we find represented in the monuments, and examples of which were presented to the Macedonian conqueror.

Besides the Anau type of dog the primitive Egyptian possessed a huge coursing hound with drooping ears, used in the chase of large animals. From what early domestication this canine race was derived is uncertain, though it may have come from India as a modified descendant of the Tibetan hound. Indian effigies of the latter date back to the second millennium before our era, but, in Egypt, hunting scenes showing the lop-eared sight-hound have come down to us from the earliest dynasties. This creature appears to

[1] Duerst, J. Ulrich. *Animal Remains from the Excavations of Anau.* Carnegie Inst. Wash., Pub. 73, 1908, p. 352. See also Keller, Conrad, *Studien über die Haustiere der Mittelmeer-Inseln.* Nouv. Mem. Soc. Helvét. Sci. Nat., vol. 46, 1911. On the ancestry of the St. Bernard see an article by H. Kraemer in Globus for 1904, Bd. 85. On early Egyptian canine races, see Hilzheimer, Max, *Beitrag zur Kenntnis der nordafrikanische Schackale*, etc. *Zoologica*, Bd. 20, Heft 53, 1908.

have been introduced into Crete, through trade relations with that island, as early as 3000 B.C., and possibly at a still earlier period was brought thither from Egypt an entirely different kind of hound, having erect ears, the origin of which is pretty certainly traceable to the Abyssinian wolf (*Canis simensis*). This "wolf", or fox, persists even at the present day in a feral state in the Ethiopian region, and appears to have been domesticated at an extremely remote period among the primitive inhabitants of northern Africa.

The supposed descendant of the erect-eared Ethiopian hound has maintained a continuous existence in Crete, from a date which may be roughly assigned to the fourth millennium before Christ down to the present day; and, what is not less remarkable, the identical strain appears to have been carried by trade routes, possibly by way of Carthage, into the Balearic Islands, and still exists there, comparatively unmodified. Thus, the modern varieties known respectively as the Cretan and Ibaza hounds, belong to an extremely ancient lineage, which may be traced in unbroken continuity back to a prehistoric domestication of a North African feral species.

The Cretan hound is abundant in the island today, and manifests all the characteristics which we should expect to find in a primitive greyhound. Historical evidence shows that, at about the beginning of the Christian era, this breed of canine was held in high esteem and became fairly widespread in the countries bordering upon the Ægean Sea. It figures frequently in ancient Cretan coins, dating from at least as far back as 500 B.C., and is readily distinguishable by its erect ears, slender flanks, and long light limbs, among pictorial representations of animals in the minor arts. The most ancient of these drawings, now preserved in the Museum of Candia, belongs to early Minoan times, or to a period corresponding to the first Egyptian dynasties. It shows a hound in recumbent posture, and is painted upon the cover of a vessel made of black steatite. Probably from this race is derived the modern Russian *borzoi*, commonly called in this country the Russian wolfhound, and also the famous long-limbed, Sicilian coursing hound of antiquity. Likenesses of these animals, stamped on Sicilian coins, attest the fondness with which they were regarded by the ancient Greek inhabitants of Trinacria. We have besides a little touch in passing from Horace (Epist., I, 2), and an account also of the chase by Oppian (Cyn. I, 480).

Writes the bard of the Sabine farm:

> ...."Venaticus, ex quo
> Tempore cervinam pellem latravit in aula,
> Militat in silvis catulus."

In which lines "venaticus catulus" indicates a young coursing hound, and "cervinam pellem" a stuffed deerskin.

Besides the hound and the heavy, mastiff-like race of hunting dog, which latter gave rise probably to the so-called *Canis molossus* and the modern St. Bernard, three other breeds were commonly raised in Europe and Asia during the period of Greek and Roman supremacy. One of these was the pariah, or street dog, already briefly referred to. Another is the shepherd, and a third is the spitz dog, this last being almost certainly derived from the jackal. These five are the prevailing pure strains, although side by side with them there flourished, as is well-known, a large number of hybrid or impure stocks.

The pariah and shepherd dog, as regards their history and characteristic traits, are too familiar to require further mention, beyond recalling that they were probably first domesticated in ancient India. That the origin of the spitz is to be sought in the domesticated jackal admits of scarcely any doubt. The fox is excluded as a possible ancestor, on account of the differently formed pupil of the eye, differences in the dentition, and a very distinct odor, which sharply separates the vulpine species from the dog or wolf. As noted by Keller, "when our domestic spitz with lowered brush and half-turned head warily holds aloof from strangers of human kind," he manifests the hereditary instinct of the jackal; and even his whine and yelp are not dissimilar. Hilzheimer regards it as certain that several varieties of the North African jackal (subgenus *Thos* of Oken) were domesticated by the ancient Egyptians; and Bekmann, in his *Geschichte der Rassen des Hundes*, is of the opinion that no less than ten varieties of canines are depicted in the monuments.

Among the favorite varieties of spitz dog in antiquity were the Maltese and Etruscan strains, and innumerable paintings of these appear in Greek ceramic art from the fifth century B.C. onward. As a household pet and lap dog, the spitz was highly prized, and

Courtesy of Boston Museum of Fine Arts

Etruscan bronze dog, found near Chiusi, Italy. Date probably about 300 B.C.

Courtesy Metropolitan Museum of Art, N. Y.

Cypriote hound seizing a hare; probably a votive offering of a hunter. From Cyprus, 300–400 B.C.

hence figures extensively in classic literature. Martial's epigram, for instance, is well known.

Finally, it may be instructive to note the observations which Arrian, a military officer in the service of the Emperor Hadrian, has written down in regard to coursing, as practised among the Gauls with both scent- and sight-hounds. In his dissertation on hunting he writes:

"The most opulent and luxurious among the Gauls course in this manner. They send out good Hare-finders early in the morning, to those places where it is likely to find Hares sitting, who send back word if they have found any, and what number; then they go out themselves, and put them up, and lay in the dogs, themselves following on horseback.

"Whoever has good greyhounds should never lay them in too near the Hare, nor run more than two at a time. For, though the animal is very swift, and will oftentimes beat the dogs, yet, when she is first started, she is so terrified by the hollowing and by the dogs being very close, that her heart is overcome by fear; and, in the confusion, very often the best sporting Hares are killed without shewing any diversion. She should, therefore, be suffered to run some distance from her form and re-collect her spirits, and then, if she is a good sporting Hare, she will lift up her ears, and stretch out with long rates from her seat, the dogs directing their course after her with great activity of limbs, as if they were leaping, affording a spectacle worthy the trouble that must necessarily be employed in properly breeding and training these dogs."

Courtesy Metropolitan Museum of Art, N. Y.

Erect-eared hound from Cyprus; 300–400 B.C.

Finally, special mention may be made of one of the subjects represented in the accompanying illustrations. Varieties of the hound, including the familiar one with erect ears, are incised in a limestone grave-stela now in the Cairo Museum. It is a royal monument found at Thebes, and dates from the 11th dynasty, approximately 2100 B.C. The following note regarding this stela has been kindly supplied by Miss Caroline Ransom, of the Metropolitan Museum of Art.

"The stela shows King Horus accompanied by one attendant and five of his dogs. The latter were evidently of a southern race, for all have Berber names inscribed in Egyptian hieroglyphs above their figures, and in three instances a translation of the foreign name into Egyptian is written vertically before the dog's breast. This stela finds mention in an Egyptian document written nearly one thousand years later than the date of its erection, namely in the "Abbott papyrus" now in the British Museum. In this document is contained the official report of the inspection of the royal tombs, under Rameses IX of the twentieth dynasty, to ascertain what damage had been done by tomb robbers. It is one of the romantic episodes of Egyptian archæology that the actual stela mentioned in the ancient document should come to light."

Museum Notes

Since the last issue of the Journal the following persons have become members of the Museum:

Annual Members, Mrs. C. Gilbert and Mrs. George M. Thornton, Dr. Henry H. Janeway, Dr. C. R. Le Fevre, Dr. Quintard Taylor, and Messrs. Edgar A. Hellman, John F. Lambden, Samuel L. Nicholson, Walden Pell, Martin J. Quinn, E. A. Cappelen Smith, Harry Wearne, and Joseph A. Zanetti.

The death of Dr. Seth Low, which occurred on September 17, at his country estate, Broad Brook Farm, deprives the American Museum of Natural History of one of its most valued friends. Dr. Low had been one of the trustees of the Museum since 1905.

Dr. Clark Wissler, during the summer, has continued his work with Mr. James R. Murie, chief of the Pawnee Indians of Oklahoma. With the aid of Mr. Murie, Dr. Wissler has secured many interesting rituals of the religion of the Pawnee which is now passing away. The more important parts of these rituals have been written down as texts in the Pawnee language with translations in English.

Mr. N. C. Nelson has been engaged for some time in a reconnaissance to determine the boundaries of glazed pottery in the Southwest. In his archæological work he has visited Ramah, Chaco Cañon, and Farmington, New Mexico. Near the latter town he inaugurated the exploration of the great ruin known as Aztec. This work, which will take several years to complete, is under the immediate charge of Mr. Earl H. Morris of the Museum of the University of Colorado. Mr. Morris, who has received a fellowship at Columbia University, will spend the year in New York.

The arrival from the Arctic of the steamship "Danmark," chartered from the Greenland Mining Company, bringing Mr. Donald B. MacMillan, leader of the Crocker Land expedition and Dr. E. O. Hovey, leader of the expedition sent to his relief, is daily expected at the time the Journal goes to press. The latest letter received from the expeditions, dated July 10, reported all well. Three members of the original expedition, Dr. Maurice C. Tanquary, Ensign Fitzhugh Green, United States Navy, and Mr. Jerome Lee Allen, have already arrived in the United States via Copenhagen. Those returning on the "Danmark" with Mr. MacMillan and Dr. Hovey, are Dr. Harrison J. Hunt, Messrs. Jonathan C. Small and W. Elmer Ekblaw, and Captain George E. Comer. At the last report the "Danmark" had been detained three or four weeks beyond her expected schedule.

Dr. Frank E. Lutz, of the American Museum, and Mr. J. A. G. Rehn, of the Academy of Natural Sciences of Philadelphia, spent July and much of August studying and collecting insects in the vicinity of Tucson, Arizona. Mr. B. Preston Clark generously contributed toward the field expenses and the Philadelphia Academy also coöperated in the work. In addition to securing specimens for the study collection, an effort was made to obtain material which would bear especially upon the problems of ecological and geographical distribution.

In order to encourage the establishment of a school of American designers and to stimulate interest in ancient art as an inspiration for modern artists, Mr. E. W. Fairchild, owner of the trade publication *Women's Wear* is offering $475 in prizes. These are specifically for the best original designs suitable for any type of woven fabric, the source of inspiration for which was found in some museum or library. The designs must be applicable to American fabrics, therefore practical qualities will receive as much consideration as artistic merit. Contestants may submit any number of designs but one award only will be made to one person. Designs remain the property of the designers, *Women's Wear* reserving only the right to reproduce the designs in black and white. Designs will be exhibited under proper conditions and the attention of mills directed toward them. The competition is open to all, and closes December 15. The judges will be Mr. H. W. Kent, secretary of the Metropolitan Museum of Art, New York City, Mr. Albert Blum, treasurer of the United Piece Dye Works, Lodi, New Jersey, and Mr. M. D. C. Crawford, research associate

in textiles at the American Museum of Natural History.

A SPIRIT of hearty coöperation with the reptile work in the American Museum has been evinced by museum authorities in New Zealand, with the object of obtaining for the Museum in the United States materials and accessories for the construction of a habitat group of the reptile *Sphenodon*. Photographs of Karewa Island, in the Bay of Plenty, where these animals occur, together with botanical and other specimens, have already been received, through the curator of the Canterbury Museum at Christchurch, New Zealand, from Mr. R. W. B. Oliver, of Auckland, a most competent observer, who sends also valuable notes and descriptions. This and other material to be shipped later will enable the American Museum to make available to the public in the near future a study group of the world's most interesting living reptile.

DR. MAURICE C. TANQUARY, the first to return from the Crocker Land expedition, on which he served as zoölogist, has been appointed assistant professor of entomology in the Kansas State Agricultural College.

THE treaty between Canada and the United States for federal protection of migratory birds, now become law in both countries, was actively supported by practically every national, state, and local organization interested in the protection of wild bird and animal life. Prominent among these may be mentioned the American Game Protective and Propagation Association, the National Association of Audubon Societies, and the more than one hundred state and local organizations affiliated with it, and the New York Zoölogical Society. The treaty provides: First, that no migratory bird important to agriculture because of insect-destroying proclivities shall be shot at any time. Second, that no open season for any species of game bird shall extend for a longer period than three and one-half months. Third, that both countries shall so restrict open seasons on game birds as to prevent their being taken during the breeding season. After the success of this important measure, for which the people of this country owe a profound debt of gratitude to the President and Senate, and especially to Senator George P. McLean, it comes as a surprise to learn that the continued existence of Lake Malheur in southeastern Oregon is threatened — one of the largest wild-fowl reservations and a natural refuge and breeding place for thousands of water fowl. A project on foot in Oregon would drain the lake and use the land, and application has been made to the federal authorities to achieve this end. It is much to be hoped that this valuable reservation, which now attracts large numbers of wild fowl from Canada, will not be suffered to disappear.

THE New York State College of Forestry in coöperation with the Lake Placid Club conducted a "forest week" at Lake Placid in the Adirondacks, July 24–28. Round table discussions in the morning, field studies in the afternoon, and an address illustrated by lantern slides and motion pictures, in the evening, constituted each day's program. Addresses were given by Mr. Melvil Dewey, president of the Lake Placid Club; Dr. Hugh P. Baker, dean of the New York State College of Forestry; Dr. J. S. Whipple, president of the New York State Forestry Association; Clifford R. Pettis, director of the forestry division, New York State Conservation Commission; Professor Henry R. Francis, landscape engineer of the New York State College of Forestry; Dr. John H. Finley, commissioner of education, Albany, New York, and Mr. Benton MacKaye, of the United States Forest Service, Washington, D. C. This is the first time a Forest Chautauqua has been held in the Adirondacks and its notable success has already suggested plans for a repetition next year.

AT the time of the ammunition works explosion on Black Tom Island, New Jersey, it was extensively noted in the public press that the seismograph at the American Museum did not record any unusual occurrence. In this connection it may be of interest to mention that a seismograph is designed to register earth movements, and the instrument at the Museum is tuned to record only such movements. The explosion of the ammunition plant produced very little if any movement of the earth, the damage done and the principal effects being due to air concussion. This would not affect any seismograph, and such slight earth motion as may have been due to the explosion was too local and inconsiderable to be recorded.

MR. ROY W. MINER spent several weeks of the summer at Nahant, Massachusetts,

to make additional studies of environment for the Nahant tide-pool group, which is now being constructed in the Museum under his supervision.

A NEW edition of the Museum's guide leaflet, "Habitat Groups of North American Birds," came from the press this summer and may now be obtained at the Museum.

MR. LESLIE SPIER has been added to the scientific staff of the Museum as an assistant in the department of anthropology. For the present, he will care for the archæological and ethnological collections exhibited from the Eastern States.

THE American Scenic and Historic Preservation Society will hold a meeting jointly with the Palisades Interstate Park Commission at the American Museum of Natural History on Thursday, October 26, at 8.15 P. M. The Honorable George W. Perkins, of the Palisades Interstate Park Commission, and the Honorable George D. Pratt, of the New York Conservation Commission, will give addresses illustrated by stereopticon slides and moving-picture films.

THE Museum's expedition to Nicaragua, under Messrs. Clarence R. Halter and L. Alfred Mannhardt, will remain in the field until January. To date, scientific collections of reptiles and fishes have been made from the eastern coastal belt — and shipments north of living specimens of *Basiliscus* and *Caiman* are being prepared for use in the reptile group work of the Museum. The expedition will now carry the survey into the mountains of the interior, to Lake Nicaragua, and the western coast.

MR. ROY CHAPMAN ANDREWS, in charge of the Museum's Asiatic zoölogical expedition, reports that nearly two hundred mammals and four hundred birds have been collected in the vicinity of Foochow, in the province of Fu-kien. Mr. Edmund Heller has joined the expedition, which on August 10 was on the way to Yunnanfu, where prospects are very good for making important collections in Yunnan Province.

DR. P. E. GODDARD visited, during the summer, the White Mountain Apache of Arizona. He made a clan census of these Indians and a study of their social organization. While among the Apache, he was very fortunate in witnessing two elaborate ceremonies for adolescent girls, securing still and motion pictures. Certain features of these ceremonies had never before been photographed.

MR. LOUIS R. SULLIVAN has been added to the scientific staff of the department of anthropology as assistant in physical anthropology. Mr. Sullivan will care for the skeletal and other somatological material in the department and will develop exhibitions showing racial differences and man's relations to the Primates.

IN response to the interest in museum exhibits as a source of inspiration for textile and costume designs, which has recently been aroused by Mr. M. D. C. Crawford among manufacturers, designers, and distributors of clothing and fabrics, the department of anthropology of the American Museum of Natural History offers a course of four lectures dealing with primitive textile arts in ancient and modern times. The lectures will be given at the Museum building on Tuesdays October 3, 10, 17, and 24, at 8:15 P. M. On October 3, Mr. M. D. C. Crawford will speak on "Special Textile Processes and Products"; October 10, Dr. Clark Wissler will speak on "Primitive Textile Arts"; October 17, Dr. H. J. Spinden will lecture on "Textile Arts of Mexico and Central America," and Mr. M. D. C. Crawford will follow on October 24, with a consideration of "The Textile Arts of Peru."

A LARGE collection of insects has been presented to the Museum by Dr. Edward B. Southwick, for many years economic entomologist for New York's Department of Parks. In addition to the insects themselves, the collection contains some fine examples of insect work in the form of nests and borings.

IN connection with the teachers' institute organized by President Wilcox, of the New York Board of Education, during the two weeks September 11–23, the staff of the department of public education of the American Museum has given a number of lectures and addresses in several of the city schools calling the attention of teachers to the opportunities they have for obtaining assistance from the Museum in coöperation with the school work. Given before audiences of teachers to a

majority of whom the subject matter was new as well as important, the lectures were especially valuable and fruitful, and several delegations of teachers have since visited the Museum to examine the lantern slides and other aids afforded. Arrangements have already been made by many teachers for systematic borrowing during the winter.

THE annual fall exhibition of the Horticultural Society of New York will be held in the American Museum of Natural History November 9–12. It will be open to members of the American Museum on Thursday November 9, from 7 to 10 P. M. and to the general public on the remaining days. It will also be open to the public on Friday and Saturday evenings, November 10 and 11.

THE Museum has had three expeditions for fossil vertebrates in the western United States during the past summer. All report a fair degree of success, especially in the discovery of new and interesting fossil faunas. Mr. Barnum Brown, in charge of the expedition for Cretaceous dinosaurs in Montana, reports the discovery of Cretaceous dinosaurs distinct from those of the localities hitherto explored by the Museum, and perhaps representing an older stage in their evolution. Mr. Walter Granger reports the discovery in a new locality in New Mexico of numerous remains of small mammals of an age intermediate between the Torrejon and Wasatch horizons. Mr. Albert Thomson has continued work in the Agate quarry, securing additional material needed for the group planned to represent this quarry fauna and has also secured interesting material from the Pliocene beds farther south. Dr. W. D. Matthew was with Mr. Thomson's party during the early part of the season, engaged chiefly in an extensive reconnaissance of the later Tertiary fossil beds in western Nebraska. Professor H. F. Osborn has since joined the party for a short time, visiting on his way some of the more important localities in Nebraska.

THE attention of teachers of biology in our higher schools is called to the synoptic series of mammals on the third floor, which has been developed with a view to making it instructive to the student while at the same time interesting to the general visitor. Although still far from completion, the exhibit is in usable shape and gives a fairly comprehensive view of the great class of mammals. It comprises not only examples of every family of existing mammals, illustrating in many cases their structure and origin in point of time, but includes also exhibits illustrating various points in the evolution of mammals, principles of classification, and interesting, or peculiar, habits. The specimens are accompanied by detailed descriptive labels giving information about the various orders and families of mammals, the series being an example of that definition of a museum, which makes it "a collection of labels illustrated by specimens." The casual visitor, by merely walking around the gallery however, may get an idea of the range of mammals in form and size, and of their more apparent characters. There are albinos and melanos, exhibits illustrating modifications for locomotion, variations of the brain in vertebrates, and the influence of environment, or adaptation of mammals to their surroundings. An introductory exhibit, showing the distinctive characters and evolutionary rank of mammals, is in course of preparation.

MR. CHARLES DAWSON, F. S. A., F. G. S., the discoverer of the Piltdown skull which proved so important a connecting link between modern man and the anthropoid apes, died recently at Lewes, England, at the age of fifty-two years. The skull was found by Mr. Dawson in a chalk pit on Piltdown Common where it had been thrown aside by laborers who were digging out flints for road mending. It proved to be one of the oldest skulls of human type ever found, dating from an early glacial epoch, when the North Sea and English Channel were dry land. It is believed to be that of a female belonging to a nomadic race without knowledge of fire and living upon uncooked roots, vegetables, and flesh. As bearing upon the problem of the relationships of early European races this discovery was one of the most important in the history of science. Mr. Dawson was well known as a geologist and author of many important papers on geology and palæontology.

A MODEL of a cave, showing the common brown bat of Virginia, *Myotis lucifugus*, is now on exhibition in the American Museum. It is thought that bats play an important part in keeping down mosquitoes, and for this reason bat towers are erected in some localities for their accommodation.

The American Museum of Natural History

Seventy-seventh Street and Central Park West, New York City

Open free to the public on every day in the year.

The American Museum of Natural History was established in 1869 to promote the Natural Sciences and to diffuse a general knowledge of them among the people. It is dependent upon private subscriptions and the fees from members for procuring needed additions to the collections and for carrying on explorations in America and other parts of the world. The membership fees are,

Annual Members	$ 10	Patrons	$1,000
Sustaining Members (annually)	25	Associate Benefactors	10,000
Life Members	100	Associate Founders	25,000
Fellows	500	Benefactors	50,000

Guides for Study of Exhibits are provided on request to members and teachers by the department of public education. Teachers wishing to bring classes should write or telephone the department for an appointment, specifying the collection to be studied. Lectures to classes may also be arranged for. In all cases the best results are obtained with small groups of children.

The Museum Library contains more than 60,000 volumes with a good working collection of publications issued by scientific institutions and societies in this country and abroad. The library is open to the public for reference daily — Sundays and holidays excepted — from 9 A. M. to 5 P. M.

The Technical Publications of the Museum comprise the *Memoirs*, *Bulletin* and *Anthropological Papers*, the *Memoirs* and *Bulletin* edited by J. A. Allen, the *Anthropological Papers* by Clark Wissler. These publications cover the field and laboratory researches of the institution.

The Popular Publications of the Museum comprise the JOURNAL, edited by Mary Cynthia Dickerson, the *Handbooks*, *Leaflets* and *General Guide*. The following list gives some of the popular publications; complete lists, of both technical and popular publications, may be obtained from the Librarian.

POPULAR PUBLICATIONS

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